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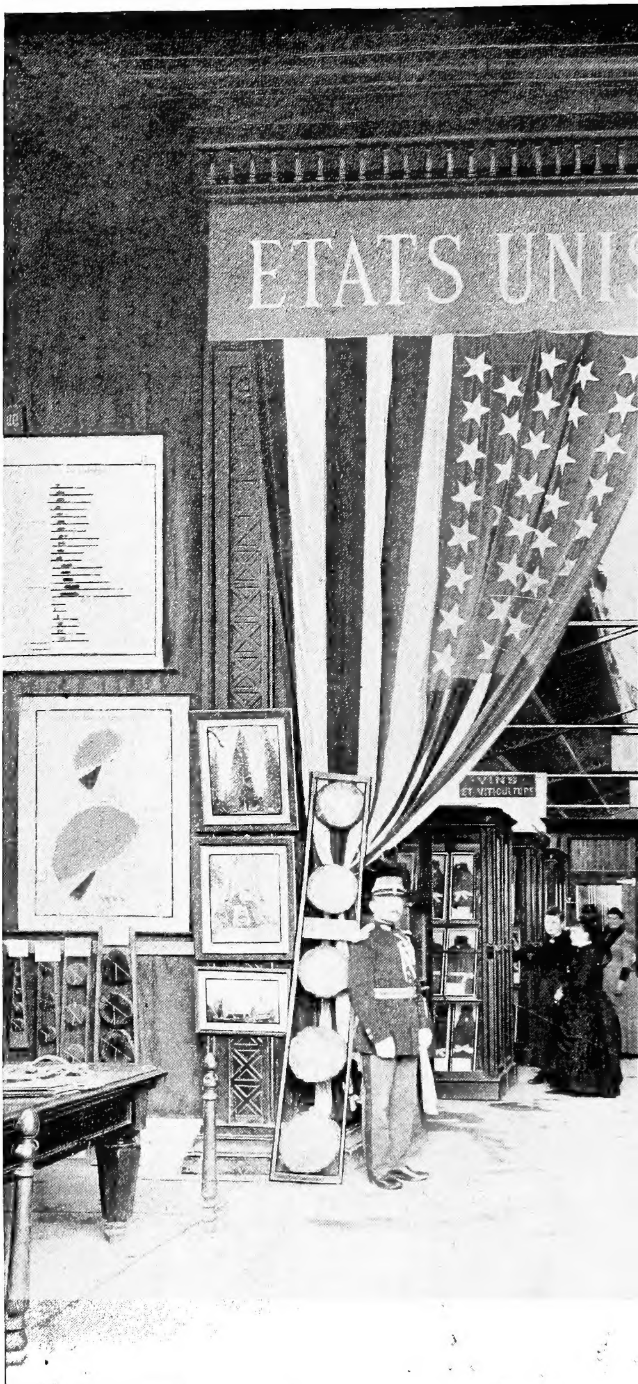

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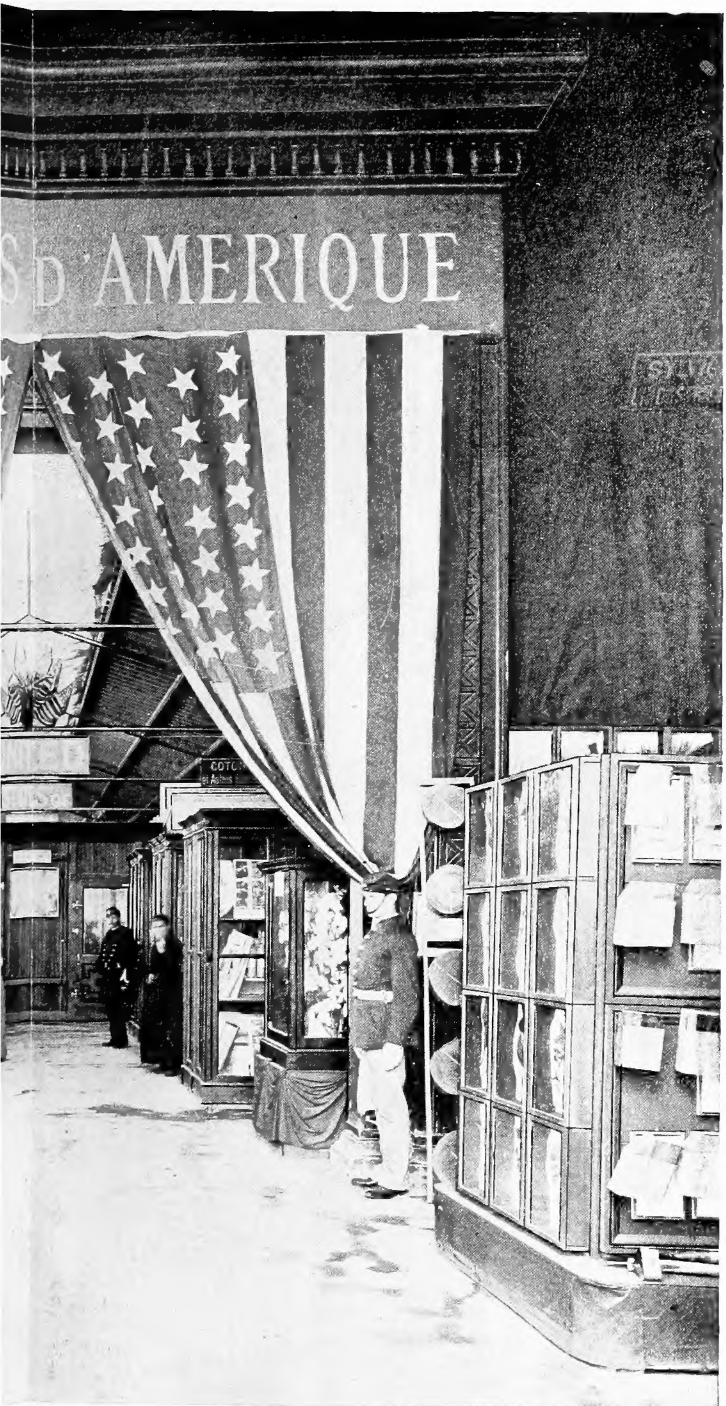

) STATES AGRICULTURAL EXHIBIT.

REPORTS

OF THE

UNITED STATES COMMISSIONERS

TO THE

UNIVERSAL EXPOSITION OF 1889

AT PARIS.

PUBLISHED UNDER DIRECTION OF THE SECRETARY OF STATE
BY AUTHORITY OF CONGRESS.

VOLUME V.

AGRICULTURE.

Edited by C. V. RILEY, PH. D., United States Expert Commissioner for the Eighth Group and Representative of the U. S. Department of Agriculture.

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EIGHTH GROUP.

AGRICULTURE, CULTIVATION OF THE VINE, ETC.

[*EXTRACT FROM THE OFFICIAL CLASSIFICATION.*]

EIGHTH GROUP.

AGRICULTURE, CULTIVATION OF THE VINE, AND FISH CULTURE.

CLASS 73*bis*. Agronomy. Agricultural statistics.
CLASS 73*ter*. Organization, methods and appliances of agricultural instruction.
CLASS 74. Specimens of farm improvements and agricultural works.
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CLASS 76. Useful and injurious insects.
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PART I.

REPORT

ON

AGRICULTURE, VINE CULTIVATION, ETC.,

INCLUDING

A REPORT ON FIELD TRIALS.

BY

CHARLES V. RILEY, M. A., Ph. D., Expert Commissioner.

Entomologist U. S. Department of Agriculture; Chevalier of the Legion of Honor (France); Honorary member of the Royal Agricultural Society of England, of the New Zealand Institute, of the London Entomological Society, and of several State Agricultural and Horticultural Societies; Corresponding member of the French, Berlin, Swiss, Belgian, and other Entomological Societies; Fellow of the American Philosophical and American Pomological Societies; of the Society for the Promotion of Scientific Agriculture, etc., etc.

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WASHINGTON, D. C., *June* 30, 1890.

SIR: I have the honor to submit herewith my report on Agriculture (Group VIII), at the late International Exposition, held in Paris, France, in accordance with the commission from President Cleveland of September 27, 1888, and the general instructions from T. F. Bayard, Secretary of State, of January 10, 1889.

I take this occasion to thank you for the many courtesies you have extended and for the sympathy you have shown in the work which has thereby been made pleasant, and which, I trust, may prove profitable to our people.

Respectfully, yours,

C. V. RILEY.

Gen. WM. B. FRANKLIN,
Commissioner-General, etc., Hartford, Conn.

INTRODUCTORY.

The Paris Exposition of 1889 differed from that of 1878 in at least one important particular, namely, in the great attention given to agriculture.

In his report upon agricultural products in 1878 Commissioner Woodman says:

At the Centennial exhibition agriculture was placed on an equality, in every respect, with other interests, and a substantial building was erected, with ample accommodations, in which were placed side by side the agricultural exhibits of every nationality represented. At the Paris Exposition no agricultural building was provided, nor was sufficient space assigned in the main buildings for foreign agricultural exhibits. Hence each of the principal nations competing was obliged to erect buildings of its own for this purpose, which were necessarily detached and unfavorably located for an international agricultural exhibition.

It is to be regretted that the agricultural products of the United States were not more fully represented. This is to be attributed to a want of means and time to collect and prepare samples of products for exhibition. It seems that the interest of agriculture as well as the financial and commercial interests of the country would have been promoted by placing on exhibition fair and well-arranged samples of all the products of our soil for which we are seeking markets abroad.

A great contrast to this state of things was shown in 1889; for not only was ample space, with convenient buildings, especially adapted for the purpose, provided for all the agricultural exhibits, but the agriculture of the United States was fully represented in a collective exhibit prepared under the direction of the Secretary of Agriculture, and which was, after that of France, admitted to be the largest and most complete of any shown at the Exposition.

By reference to the plan of the Exposition grounds it will be seen that the agricultural galleries occupied the entire length of the Quai d'Orsay from the Champ de Mars to the Esplanade des Tuilleries. There was a double row of these galleries, consisting of substantial iron-framed sheds, one story in height, and of a nearly uniform width of about 40 feet, but of varying length. The total length of these galleries was about 7,000 feet, the space covered was 9.06 acres, and uncovered 6.65 acres; *i. e.*, 14.71 acres were devoted to the exhibits.

Six of these galleries were allotted to France, while the two smallest were given to Great Britain, and the remaining two, including the longest, were divided among other countries, viz, the

United States, Russia, Switzerland, Belgium, Holland and Luxemburg, Italy, Austria, Norway, Roumania, Denmark, Australia, and New Zealand. Roughly estimated, the division of space was as follows:

	Per cent.		Per cent.
France	62.0	Belgium	2.5
Great Britain	11.0	Australia	2.0
United States	6.5	All others	10.0
Russia	3.0		
Switzerland	3.0		100.0

Spain and Portugal had separate buildings upon the Quai and showed their agricultural in connection with their alimentary products. Greece, Servia, and Japan included their agricultural with their industrial exhibits in the palace of the Champs de Mars. Algeria, Tunis, and other French colonies and protectorates had special buildings upon the Esplanade, while the South American countries generally had their own buildings upon the Champs de Mars and included their agricultural with their general exhibits. Germany was not represented at the Exposition.

In general all the exhibits, described later in detail, were very complete and most carefully arranged, and except from Germany, there seems to have been a general response among the nations to the request for agricultural exhibits, though two of the smaller countries failed to make any display in this branch of industry.

In addition to these exhibits there were two general shows of live stock, one of cattle, sheep, etc., held at Paris in July, and one of horses in September. There were also periodical exhibits of vegetables and fruits upon the Trocadéro, several competitive trials of agricultural machines, dairy appliances, spraying machines, etc., notably the one at Noisiel, and, finally, an international congress of agriculture, with its attendant excursions, was held, among other congresses, in July.

In preparing this report it has been my endeavor, as far as possible, to bring out the advances which the Exposition showed as compared with the previous Exposition of 1878; and in the preparation of the different chapters I have tried to avoid repetition of what was published in the reports of the Commissioner on the eighth group in 1878.

The scheme of classification for the Exposition, so far as the agricultural groups are concerned, was neither logical nor practical, nor was there much pretense to follow it in the exhibits themselves by the different countries exhibiting. Consequently, in preparing this report on the eighth group, I have desired to present a report that would represent as far as possible the agricultural interests as shown at the Exposition. It was therefore mutually agreed in the beginning, with the sanction of Gen. Franklin, that class 77, relating to aquatic animals (fish and crustacea, etc.), should be

reported on by Mr. A. Howard Clark in the seventh group, while class 71, vegetables and forage plants, and part of class 67, cereals, should, in exchange, be included in the report on the eighth group.

In the French table of general classification cereals in the grain are placed under class 67, and vegetables, *i. e.*, tubers, farinaceous seeds, roots, fruit, and green vegetables, under class 71, both of which classes form part of the seventh group, which is wholly devoted to alimentary products. Green vegetables are also placed under class 80, in the ninth group, which treats of horticulture, but it is remarkable that neither cereals nor vegetables are given any place whatever in the classification under the eighth group, which is properly agricultural and under which the most serious consideration of such products would naturally be expected.

In the French exhibit both cereals and vegetables were properly considered as agricultural products, and as such were shown under class 74, belonging to the eighth group, and are so catalogued, while the exhibits in the classes 67 and 71 consisted exclusively of alimentary products derived from cereals and from vegetables, respectively. Algeria and the Argentine Republic partly followed the example of France in their manner of exhibits, but the other nations generally followed the classification of the catalogue more closely, showing cereals and their products in class 67, and vegetables, together with the alimentary preparations derived from them, in class 71.

A person writing upon class 74 and strictly following the classification alone would altogether leave out the very important show of cereals and vegetables in the French exhibit, while should he follow the catalogue only he would describe the cereals in less than half of the foreign countries, and the vegetables only in one or two small countries other than France. In writing up class 71 in the French section and only describing what was catalogued and is to be seen in the "Palais de l'Alimentation" he would describe only about one-third of what is mentioned in the classification. In Chapter I, therefore (substantially class 71), is included the report on vegetables, together with cereals in the grain, or, treated in a strictly agricultural sense, the purely alimentary part of 67 to be reported by Mr. Clark in the seventh group. This arrangement is further justified by the fact that in 1878 Commissioner Woodman included classes 79 (corresponding to our class 67) and 73 (our class 71).

This chapter, which has been prepared at my request by Mr. Amory Austin from his own notes and observations at the Exposition, contains a full account of vegetables, forage plants, and cereals as shown by the different countries. And here, again, Mr. Austin has made his report most full in those particulars in which the report of 1878 was least complete. Of these particular products some countries made a better showing in 1878, judging from their reports, than they did in 1889. This may be said of Norway, Greece,

Portugal, Italy, Sweden, and Canada; whereas Roumania, Servia, most of the Central American and South American countries, the French colonies, the South African Republic, Japan, and the Sandwich Islands were all better represented in 1889. In this chapter is included an account of mushroom culture. Mushroom-growing in the cellars, quarries, and catacombs throughout Paris was fully described in the horticultural report by George W. Campbell in 1878, but without illustrations. The information in the present report which Mr. Austin has brought together is largely additional to that recorded by Mr. Campbell; whereas, a mere reference is made to the Generilliers sewer farm, which is very fully described by Mr. Campbell, leaving little to be added.

In Chapter II I have been led to give reviews of some of the organizations, governmental and civil, which exist abroad for promoting agriculture, and particularly those of the French Republic; for we have yet much to learn from the systems there prevailing. France has long been one of the wealthiest of European nations through her specialties and her thorough methods of applying science to industry, and these are in no small degree the outgrowth of her general agronomic systems.

The history of our own efforts looking toward the establishment of national associations of an agricultural character is, substantially, one of failure, and the vastness of our territory will always make it difficult to continue for any length of time any such national body in a truly representative way; but there is no reason why some of the French methods might not be profitably adopted. No reference is made in this chapter to the statistics and organizations of Germany, Great Britain, Spain, Portugal, and some of the northern European countries, for the simple reason that these countries made no exhibit upon which to base a report.

Chapter III, on organizations, methods, and appliances of instruction, has been made quite full, believing that with the recent organization of our own State experiment stations and with the impetus given to agricultural experiments and education, a consideration of the methods abroad, especially in France, will be of decided advantage to our people in any report on the agriculture of the Exposition. I can not but feel that we might profitably copy in many directions, and especially the French system of recompense and of missions, by which the best men are constantly selected for important work which is to benefit the State.

The simple and inexpensive system of experiment stations, wherein, by reciprocal arrangement, both the State and the farmer on whose farm the experiments are made, derive benefit, is well worthy of being followed. The Ministry of Agriculture in France is so organized that the Director of Agriculture remains substantially a permanent officer. The present incumbent has held the position for some

twenty odd years, thus giving a stability to the establishment in striking contrast to the notorious instability of the ministry. Something similar will be necessary in our own National Department of Agriculture, and we might profitably adopt a system similar to that of France that would give the Department one permanent officer who should be sufficiently severed from politics and independent of changes of administration.

Chapter IV is based on class 74, which included specimens of farm improvements and agricultural work. In reality this class was of a decidedly miscellaneous character at the Exposition and seems to have been used for almost everything which had no special place elsewhere, or that was crowded out at the last moment. Among the foreign exhibits the example of France was sometimes followed and sometimes not. There was, in fact, much confusion, and the labor of preparing a report upon the class was by no means lightened thereby. A more definite classification and strict adherence to it is a desideratum for future expositions. Some matters strictly belonging to this class have already been included in Mr. Austin's Chapter I, such as the Sahara irrigation lands, Tunisian farms, and the "Polders" of Holland. As it is prepared the chapter includes accounts of some of the model farms of France. The admirable manner of combining on one farm the most diversified and most scientific culture which prevails on some of the best farms of France ought not to be without its lesson, and I see no reason why a similar system, adapted to American climate and wants, should not prove successful with us, especially near our large cities, and bring into profitable use many of the abandoned farms of New England. As already stated, this class, according to the French exhibit included the grains and forage plants which, however, have already been treated of in Chapter I. They would, indeed, not be out of place in this particular class, except in so far as they involve methods of handling and baling; but I have preferred to treat of some other matters which more appropriately belong here and in which there has been the most marked improvement since 1878. Among these is ensilage. Mr. Knight gives a very full description in the report for 1878 of the system then in vogue and of underground silos. Since then, the system has materially changed; for in France underground silos are no longer generally used, but, instead, open-air stacks. I have also included some account of hops, cider appliances, presses for olive oil, and of dairy appliances, in which the advances have been great, and finally appliances for poultry-raising, the French being far ahead of most other countries in the perfection of their arrangements for this particular industry.

In Chapter V I have included principally the consideration of machinery that was particularly tested in the different field trials held during the Exposition, believing that more practical informa-

tion is thus obtained than by a consideration simply of the machines on exhibit, and their merits as expounded by the inventors or agents. After a good deal of reporting in past years on machinery at our State and county fairs, I am convinced that the important facts are most likely to result from such actual trials. This chapter does not strictly come within the eighth group, but belongs essentially to class 49, which, however, is closely allied to class 74; and I have prepared the report on field trials at Gen. Franklin's request. Here, again, I have endeavored to confine the notices and illustrations as much as possible to the machinery introduced and perfected since the Exposition of 1878, thus making them as far as possible supplemental to the extended and admirable report by Dr. Edward H. Knight on the machinery of that year.

A host of steam engines, both stationary and portable, for farm use were exhibited in class 49, and here again the prevailing tendency already noted towards increasing simplicity and lightness, combined with greater efficiency, was plainly shown. A like advance was noticed in machines for thrashing grains and in the divers mills for preparing crops for the food of animals, including straw-cutters, grain-crushers, oil-cake breakers, root-cutters, and food-cooking apparatus. But on all these subjects I have made no report.

Of the several groups of machinery represented in these trials the second group—apparatus to filter wine and its sediments—will be treated in connection with a special chapter on wine-making; the third group, comprising insecticide and fungicide machinery, is treated independently of the matter contained in Chapter VI (class 75); the fourth group, dairy apparatus, is not considered, as arrangements were made by Commissioner Franklin for a separate report by Prof. Jas. Cheesman. In the sixth group, apparatus for gathering, preparing, drying, preserving, and packing of dry fruits, there were no entries and hence no trials. The seventh group, comprising machines and apparatus for the decortication of ramie (rhea or China grass) is fully considered in a special report to Commissioner Franklin by Charles R. Dodge, and hence further reference to this group is omitted.

The classes of farm implements particularly treated are: The first Group, comprising seeders and distributors of fertilizers (and insecticides); and the fifth, Group V, including mowers, reapers, twine-binders, and hay presses.

The field trials and exhibits in the last-mentioned group were of greatest interest, not only from the important part taken by American exhibitors, but also from the very marked improvements effected since 1878, particularly in the self-binding reapers.

A number of important classes of farm implements were not entered for competitive trial. Among these may be mentioned plows and implements for the preparation of the soil for crops, threshing

machines, grain and seed cleaners and separators, forage and root cutters, horse power and cooking apparatus.

All of these classes were exhaustively treated in Mr. Knight's report, however, and the improvements which have been effected since 1878, not only in the classes of machines just mentioned, but in most agricultural implements, are, in general, slight, and do not warrant very full consideration of the subject again. I do not wish to imply that there have been no important improvements, but that these have consisted, rather, in the working out and perfecting of details which have resulted in securing lightness in weight and draft together with greater solidity and durability.

Absolute novelties were few. Important among these may be mentioned the straw-binding harvesters exhibited by W. A. Wood, of Hoovers Falls, New York; the tree-planting machine exhibited by B. E. Fernow, of the United States Department of Agriculture; the Dowdet pea-shelling machine for the shelling of green peas and beans, exhibited by N. Thullier of Paris; and the various systems of centrifugal cream separators.

The manufacture of insecticide and fungicide machinery on a large scale has been greatly developed since 1878, and in France as well as in the United States has become an important industry, and demands the attention given to it in this report. The American exhibit in this class of machines was limited to the display made by the United States Department of Agriculture, which consisted chiefly of a series of models illustrating the development of the Riley or cyclone nozzle.

It is to be greatly regretted that a larger number of American manufacturers of farm implements did not take part in the Paris Exposition of 1889. The comparatively large number of valuable awards secured by those who took advantage of the opportunity offered by the Exposition to advertise and exhibit their machines is gratifying. It is well known that in the manufacture of agricultural implements the United States leads the world, and the insufficiency of our exhibit was, therefore, a subject of frequent comment, as it failed to correctly represent our present status in this important industry.

Chapter VI (Class 75), is devoted entirely to the vine. At this Exposition viticulture was first made the object of a special class. The struggles which this industry has had to undergo and a study of the consequences likely to result from its abandonment, together with the important progress made of late against all its enemies, fully warrant the favor which was accorded to it at the late Exposition.

In going through the galleries of Class 75, one was impressed with the considerable efforts made by the French Government to preserve to the national vineyard its supremacy over all the other vineyards of the world. The defense of the French vineyard is possible, and the reconstruction of parts formerly destroyed is at present making

great progress. The use of bisulphide of carbon or of sulpho-carbonate of potassium, of submersion and planting in sand as remedies against Phylloxera, and the use of salts of copper against mildew, have to-day become recognized and successful means of direct warfare, involving the use of a great variety of apparatus; while the prevention by the use of resistant American stocks is overcoming all opposition and is, more than all other methods combined, redeeming French viticulture. It is largely the work of French viticulturists that has solved the various questions arising from the crisis occasioned by the advent of the Phylloxera. In 1875, the wine harvest amounted to nearly 84,000,000 hectoliters, the previous annual mean having been 50,000,000; but in 1876, the production had fallen to 42,000,000 hectoliters, and in 1879 it was only 25,000,000. Of the 2,500,000 hectares which comprehended French vineyards, 1,000,000 hectares had been destroyed by this redoubtable parasite.

But, thanks to the energy developed in replanting, French vineyards now comprise 2,000,000 hectares, which in 1888 yielded a harvest of 32,000,000 hectoliters (the harvest of Algerian vineyards, amounting to 1,000,000 hectoliters, is not included in the above). It is not doubtful that before many years the area formerly planted will be reattained, and with a production very sensibly exceeding the mean of former years of prosperity, thanks to the employment of more rational methods which research has indicated.

It appears from official documents that 75,000 hectares have been treated with bisulphide of carbon or sulphocarbonate of potassium; that submersion has been applied to 27,000 hectares, and that nearly 200,000 hectares have been actually reconstructed by means of American vines. To these figures must be added the 16,000 to 17,000 hectares planted in sand.

In this report I have reviewed the exhibit somewhat briefly in order to devote more space to subjects which are of greater importance to the American viticulturist. These include a review of the methods of cultivating the vine in France, and a consideration of the subject of wine making. The chapter naturally divides into three parts, therefore:

Part I, a brief survey of the exhibit;

Part II, cultivation of the vine; and

Part III, wine making.

The French methods of vine culture, which are well suited to the conditions obtaining in France, would be, to a certain extent, impracticable in the United States; yet much may be learned from a study of these methods, particularly of propagation and grafting, in view of the success which has attended the effort against the Phylloxera and cryptogamic diseases.

Wine making, however, in which the French excel, is a subject of greater interest to us, and it has been treated somewhat at length

from the gathering of the grapes to the finished product ready for the market.

In the preparation of this chapter I have consulted and drawn chiefly on the following publications:

Boireau. Traitement pratique des Vignes. Bordeaux, 1884.
Ferret. Bordeaux and its Wines. (English edition.) Paris, 1883.
Foëx. Manuel pratique de Viticulture, 4e édit. Montpellier and Paris, 1887.
Mayet. Les Insectes de la Vigne. Montpellier and Paris, 1890.
Portes et Ruyssen. Traité de la Vigne, Tomes I–III. Paris, 1886, 1888, 1889.
Rougier. Manuel pratique de Vinification. Montpellier and Paris, 1889.
Sahut. Les Vignes Américaines, leur Greffage et Taille, 3e édit. Montpellier and Paris, 1887.
Tochon. L'Art de faire le Vin, 2e édit. Montpellier and Paris, 1888.
Viala. Une Mission Viticole en Amérique. Montpellier and Paris, 1889.
——. Les Maladies de la Vigne. Montpellier and Paris, 1887.
Viala et Ferrouillat. Manuel pratique pour le Traitement des Maladies de la Vigne. Montpellier and Paris, 1888.

A host of additional French works and pamphlets dealing with various viticultural subjects have been at my command, which, however, need not be particularly mentioned.

The illustrations have either been taken or copied from the works named, or from the trade catalogues of French manufacturers.

I made a special trip in August, 1889, to the Bordeaux region, spending about a week in the Médoc and Sautern vineyards; but seeing clearly, since my return, with the pressure of other duties, that time would not permit me to do justice to the subject, I have turned over my notes and the collected literature on the subject to Mr. C. L. Marlatt, who has prepared the part on wine-making.

Mr. Marlatt has also prepared Chapter VII (Class 76) of the report on useful and injurious insects.

In sericiculture the general status of the industry in France, together with statistics of the production of cocoons and eggs, is given. The exhibits of other countries are also briefly described, and an account is given of the system of supervision and inspection practiced by the Government of Hungary.

The apicultural exhibits of France were of inferior character, few in number, and scattered. Concerted effort to make a good display was lacking—the show consisting of the exhibit of a few societies and individuals. Exhibits of some value were made by Austria, Belgium, and Great Britain, and small or inferior displays by a number of other countries.

Other useful insect products exhibited were cochineal, by the Argentine Republic, and cantharides in the French section.

After the Phylloxera, of insects injurious to agriculture, the destructive locust of Algeria figured most prominently in the exhibit, and was illustrated in its several phases, together with the methods adopted to destroy it.

The importance of the Grape-vine Phylloxera to France and other

wine countries warranted the very full exhibit of all that pertained to this great enemy of the vine; and, in fact, the exhibit of apparatus and methods employed against injurious insects related almost altogether to this one pest, and it has therefore been given especial attention in the report.

In the appendices I have added in Appendix I a short report on exhibits of live stock held during the Exposition, and in Appendix II, a report on the horse show.

Mr. Dysart, in the report on the Exposition of 1878, fully discusses the subject of Shorthorns, Devons, Herefords, Longhorns, Polled cattle, Ayrshires, Jerseys, Normandies, Charolaise, and Limousine breeds; so they are but briefly referred to in my report without description. My notes in reference to the Kerrys and the Hollandaise (or Angelen) races, as also of the Swiss cattle, give further particulars, while some reference is made to the Algerian cattle, not mentioned in the previous report. As Mr. Dysart treated extensively of sheep, and there is relatively little that is new to record, I have but little to say upon them, and simply give a survey of the show, with some mention of the few new breeds. There was no dog show connected with the Exposition of 1889, that given in Paris being of a private character. The report on the horse show is from a somewhat different standpoint, as compared with that of 1878.

In reviewing the exhibits of the different countries in the group and parts of groups alloted to me, I have omitted in every instance the United States, for the very good reason that my work at Paris was of a dual nature and the United States exhibit is fully treated of in the second part of this volume, to which the reader interested in said exhibits is referred.

In dealing with the various moneys, weights, and measures of the different countries, it has not been deemed necessary in all cases to premise by a tabular statement giving the American equivalents. Wherever in the text such equivalents have been deemed desirable they are inserted in parenthesis. This is also true to some extent of French weights and measures; but as some of these are of constant occurrence, I have thought it best to add here in a footnote, for convenience sake, the more important of them.*

**Length*.*—Millimeter (1-1000 of a meter) = 0.0394 inch; centimeter (1-100 of a meter) = 0.3937 inch; decimeter (1-10 of a meter) = 3.937 inches; meter = 39.37 inches; kilometer = 0.62137 mile, or 3,280 feet 10 inches.

Surface.—Hectare (10,000 square meters) = 2.471 acres; are (100 square meters) = 119.6 square yards; centare (1 square meter) = 1,550 square inches.

Weight.—Milligram = 0.0154 grains (avoirdupois); gram = 15.432 grains (averdupois); kilogram = 2.2046 pounds.

Capacity.—Liter = 1.0567 quarts; dekaliter = 2.6417 gallons; hectoliter = 26.417 gallons.

Coins.—Franc = 100 centimes = $0.192. [From these figures it will be seen that for rough approximations it will be sufficiently accurate to estimate the franc as equal to 20 cents; the meter as 3 feet 3 inches; the kilometer as ⅝ of a mile; the square meter as 11 square feet; and the hectare as 2½ acres.]

In closing this introduction to the matter of my report it is with genuine pleasure that I recall the courteous aid uniformly given where requested, whether by exhibitors or others in attendance at the Exposition. The minister of agriculture, M. Faye, and the director, M. Tisserand, have been uniformly kind, the latter helping with information and documents. It would be obviously impossible to enumerate all to whom I am thus under obligations, but for special courtesies I would publicly thank, among many others, the following gentlemen: Bernhard Böggild, Copenhagen; P. Bonesco, Bucharest; Dr. Victor de Hagara, member of parliament of Hungary; T. Cartuyvels, director of agriculture, Belgium; Henry Sagnier, editor of the Journal de l'Agriculture; O. Cazauvieilh, deputy of Gironde; Eugène Risler, secretary of the Institut Agronomique; Emile Rivière, editor of the Revue Scientifique; Jules Laverrière, of the national agricultural library of France; Prince Leon Galitzine; Baron Thénard; Edouard Hunnebelle, counsellor general of Algeria; F. Ruyssen and Charles Nicolas, inspectors of agriculture in Algeria and Tunis; Basile de Bertheuson of Odessa; Albert Tachard, honorary secretary of the Société des Agricultuers de France; M. Rousseau, editor of L'ami du Cultivateur; S. Bastide of the Chamber of Commerce, Montpellier; Lucien Daubrée, Paris, director of forests.

Of those who have more materially aided me in the preparation of the report, my special acknowledgments are due to Louis Grandeau, Paris, inspector and director general of agronomic stations, and Count Foucher de Careil, Paris, for information on statistical and educational matters; to George Couanon, inspector-general of Phylloxera service, for notes on class 75; to Henry Grosjean, inspector of agricultural instruction for courtesies and information in class 73 *bis;* to H. Mesnier for valuable notes and translations on the subject of class 73 *ter;* to Maximilian Ringelmann and Henry Sagnier, whose judgments and writings on the subject of agricultural implements I have followed somewhat closely; and to Mr. C. L. Marlatt, one of my assistants, for general aid and for the preparation of Part III of Chapter IV, on wine making, as also Chapter VII, useful and injurious insects. Lastly, my warmest acknowledgments are due to my clerk, Mr. Amory Austin, for his unfaltering aid. Coming to me as a stranger, with little previous experience of agricultural matters, he grew so interested in the work that I felt justified in intrusting to him the report on class 71. With his single aid and that of a graphophone an amount of work was accomplished that often taxed our patience and our powers, and one of the most pleasant memories of the Exposition will ever be connected with the humble office in which we received peasant and potentate alike, and in which Mr. Austin shared with me the trials and pleasures which are incidental to exposition work.—C. V. R.

CHAPTER I.

CLASS 71.—VEGETABLES, FORAGE PLANTS, AND CEREALS.

By AMORY AUSTIN.

Tubers, potatoes, etc.
Dry farinaceous vegetables; beans, lentils, etc.
Green vegetables for cooking; cabbages, etc.
Vegetable roots; carrots, turnips, etc.
Vegetables used for seasoning; onions, garlic, etc.
Salads, gourds, pumpkins, melons, etc.

An examination of the above list shows that the first two thirds of it relate either to such vegetables and fruits as can be freshly gathered for immediate consumption, or to such as can be stored for future use without any other preparation beyond ordinary cleansing, drying, and packing in suitable receptacles, while the remaining third has reference to vegetables or fruits which have undergone various forms of preparation necessary to preserve them in a wholesome condition for a long time or for transportation.

It is this last third of the list which constituted the whole exhibit of the French section in Class 71, the rest of the list being exhibited along with "specimens of farm improvements and agricultural works" in Class, 74 where they are no doubt shown as products of farm management or results of various systems of culture.

The preserved vegetables and fruits of Class 71 are, in an alimentary sense, so closely connected with the preserved animal products of Class 70 that many exhibitors showed products of the two classes side by side. Thus, in the French exhibit there were, out of 110 exhibitors, 56 who showed animal products, 32 who showed vegetable products, and 22 who showed both.

As might have been expected, France made a notable and important exhibit in this branch of industry. Almost every known edible of vegetable origin was there represented in one form or another, while the richness of the display, the proverbial good taste of the French, shown in making an attractive arrangement of their *vitrines*, and, above all, the appetizing appearance of the wares themselves,

caused this to be regarded as one of the most remarkable exhibits upon the Quai d' Orsay.

The vegetables and fruits exhibited in this section were preserved by the two well-known general methods: first, by desiccation, with its various modifications, and secondly by the process of preservation in hermetically sealed packages, originated by François Appert in 1804, and since improved by him and by others, principally in France.

No very strikingly new methods of preservation were shown. A competition of "materials and processes for gathering, preparation, drying, preservation and packing of fruits" was announced for the latter half of August, but no competitors came forward. There were in the whole Exposition but two exhibits of such a nature, both French. One was that of Fouché, who showed special apparatus, such as kettles, etc., and notably an improved form of drying chamber, applicable not only to meats and fish as well as to vegetables and fruit, but also to the drying of printed sheets, etc.

The other was a process of preserving fruits by cold, by E. Salomon, of Thomery. Of interest also in this connection is the *Écosseuse* or machine for shelling peas, which does its work very thoroughly.

There were in the French alimentary section only two exhibits of vegetables preserved by simple desiccation. One was that of Lapostolet Frères, who showed peas, lentils, and beans of various sorts dried and decorticated, as "split peas" and also ground into flour. These had undergone a process of cleansing and assorting by sizes made by appropriate machinery, which is an adaptation of the *trieur* or grain-separating machine; the refuse of the operation was shown with the finished product.

The other exhibit was that of Prevet et Cie., who showed a large collection of dried vegetables, including carrots, turnips, potatoes, cabbage, brussels sprouts, celery, onions, flageolets, and string beans (*haricots verts*), all cut into thin ribbons or slices and completely desiccated by appropriate machinery. These are put up separately or in mixtures, such as *julienne* or *macédoine*, ready to be used in soups, etc., and are either loosely packed or compressed into cakes. This house uses a special process, and annually preserves from 6,000,000 to 10,000,000 kilograms of vegetables in this way. In order to show the perfection of their process, these exhibitors had a show case of cabbages and one of carrots and turnips with their tops on, all dried without losing their natural form, and ready for use as *julienne*.

The only dried fruits exhibited were prunes (noticed farther on), although raisins, figs, apples and pears, and many other fruits are habitually preserved in this manner in France. The greater part of the vegetables and fruits in this section were preserved by Ap-

VEGETABLE EXHIBIT OF

VILMORIN-ANDRIEUX ET CIE.

pert's method. Among the vegetables were asparagus, whole or the tops alone, artichokes, with or without their leaves, beans of all sorts, red beets, carrots, cauliflower, celery, cèpes, *haricots verts*, *moelle de cardon*, morilles, mushrooms, green peas, tomatoes, and turnips. Olives were shown in great quantity, while other fruits, such as apricots, cherries, peaches, pears, and various varieties of plums (*reine-claude*, etc.) were shown, preserved in brandy. An American examining this exhibit would have observed the entire absence of preserved green corn, or of "succotash," so common at home. Here, too, were mixtures of vegetables prepared for garnishing dishes, or for soups, etc. One exhibit consists of green peas, string beans, carrots, *cèpes*, artichokes, etc., preserved by Appert's process for the Exposition of 1878 and still in good condition after 12 years. Pickles of various sorts were also shown, principally cucumbers, cauliflower, string beans, red pepper, and various mixtures; also a pickle made of small, undeveloped whole ears of green corn, from 3 to 4 inches long. The French are not particularly fond of pickles, and do not go into their manufacture very extensively.

Especially to be noticed among these articles was the manner in which both vegetables and fruits were put up in the glass jars or bottles which contain them, in an attractive or in even an artistic form; vegetables were cut into regular or ornamental forms by appropriate tools, and regular patterns are made in the jars, each piece being carefully laid in its proper place; the quincunx is naturally the usual pattern for small, round fruits, but this was varied by using fruits of different colors. Very often designs, letters, etc., cut out of beets, carrots, or truffles, were inserted among the vegetables, or large mushrooms were cut into rose patterns. Pains seem to have been taken to make each exhibit as attractive as possible, and the whole class had "a more appetizing look than was elsewhere seen in the Exposition."

An improvement has been made in the manner of using chlorophyll as a substitute for dangerous copper salts in giving to vegetables an attractive green color. This use of chlorophyll dates from 1877. After its extraction from spinach or from the waste tops of carrots, turnips, etc., by means of caustic soda, it was formerly made into a lake with alum, and then rendered soluble by alkaline phosphates; this instable solution was then added to the vegetables to be colored and easily yielded to them its coloring matter in the regular course of Appert's process. The improvement consists in partly neutralizing the alkaline solution of chlorophyll with very weak nitric acid, and completing the neutralization by means of acetate of alumina; upon adding this solution to the water in which the vegetables are bleached, and heating 100° to 125° C. (212° to 257° F.) by means of a bath in which sugar and common salt are dissolved in order to raise the boiling point, the chlorophyll is

perfectly fixed upon all the green vegetables and fruits. The house of Lehucher et Cie, of Paris, operates upon from 8,000 to 10,000 kilos of green peas daily with perfect success. (For notes upon chlorophyll lakes see "Comptes Rendus de l'Academie des Sciences," April 9, 1887, p. 685, and May 7, 1887, p. 985.)

Among the most interesting articles displayed in the French ex-

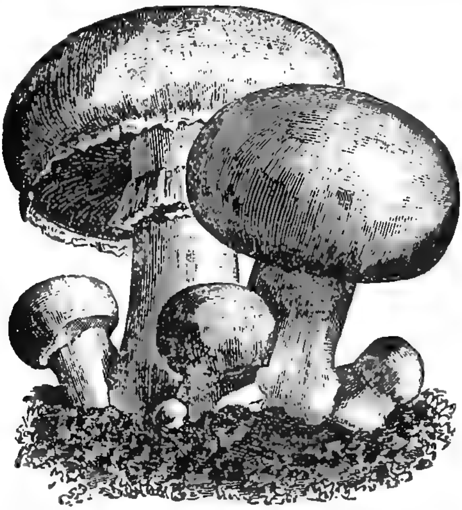


FIG. 1.—Edible mushroom. *Agaricus campestris*, Lin., *A. Edulis*, Bull. (From Vilmorin.)

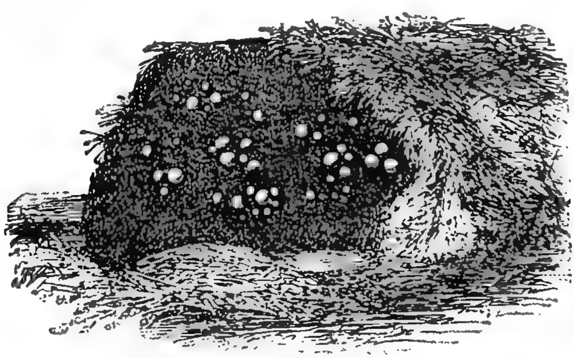


FIG. 2.—Mushroom bed with two sides partially uncovered. (From Vilmorin.)

hibit were mushrooms and truffles. French mushrooms are widely known and universally appreciated. Paris and its environs are the principal places where they are cultivated, though they are also grown at Lille, Caen, Vendôme, and other places in France. There are many edible mushrooms, but the common meadow mushroom (*Agaricus campestris*, Lin., *A. edulis*, Bull., Fig. 1), of which there are several varieties, is the only one well adapted for culture. The method of planting the spawn or *blanc de champignon* upon long beds, generally of stable manure, is the one most frequently prac-

ticed. This is done chiefly in the subterranean galleries of abandoned quarries in and around Paris. (Figs. 2, 3, 4, and 5.) These

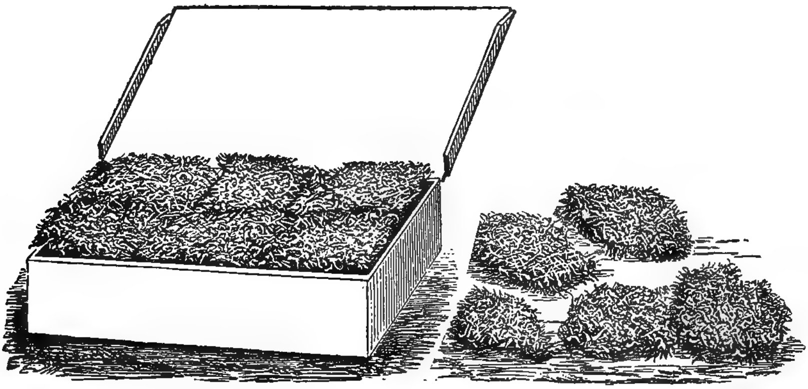


FIG. 3.—Mushroom spawn and box. (From Vilmorin.)

galleries and the method of culture have been well described by Commissioner George W. Campbell, in his report upon Horticulture at the Paris Exposition of 1878, (see Report, Vol. v, p. 389), and there is but little to add to his description. Mushrooms thus cultivated, or *champignons de couche,* are the only ones tolerated by the police at the Paris markets. Open-air cultivation is also practiced, and there is a method of cultivation without manure, by means of saltpeter. In 1883 the mushroom culture at Paris amounted to 25,000 kilos daily, which is at an average price of 1 franc per kilo, gives a sum total of 9,125,000 francs (or $1,825,000) yearly. Mushrooms may be easily preserved by drying or by Appert's process, and were thus shown in the French alimentary section.

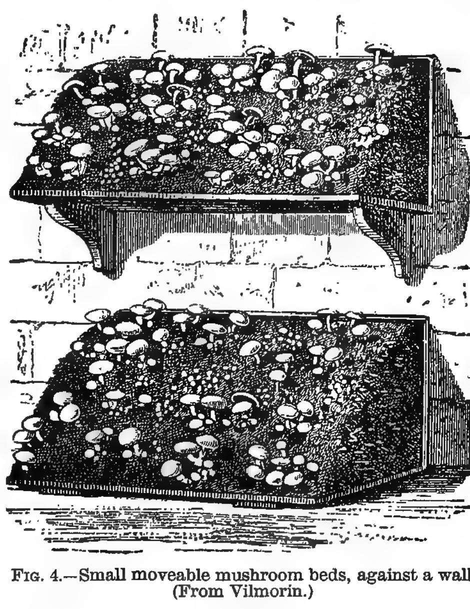


FIG. 4.—Small moveable mushroom beds, against a wall. (From Vilmorin.)

FIG. 5.—Moveable shelf for growing mushrooms. (From Vilmorin.)

Two other sorts of mushroom are much esteemed as delicacies at Paris, namely, the *cèpe* and the *morille.* Cèpe is a popular name given to various mushrooms of the boletus family, of which there are about a hundred different varieties, though only nine of them are enumerated as being edible. Many of the varieties are very poisonous. The edible boleti (Fig. 6) are generally large and fleshy, of various shades of gray or of chestnut to cinnamon or very dark brown, sometimes inclined to olive. The under part of the head is white or grayish and the flesh is white or yellowish-white. There is also an edible orange-colored variety. The ordinary cèpe (*B. bulbosus*) is often from 10 to 25 centimeters in diameter and is found in the woods during the summer months. The most delicate, or *cèpe de Bordeaux* (*B. edulis*), is found in April or May. To produce good cèpes May should be hot and rainy. A few come from Fontainebleau, though the greater quantity is found, generally in chestnut woods, in Limousin. Cèpes are never cultivated. They are said to be very nutritious and may be cooked when fresh, or may be dried without cooking or preserved by Appert's process, in the same way as the ordinary mushroom, or in olive oil.

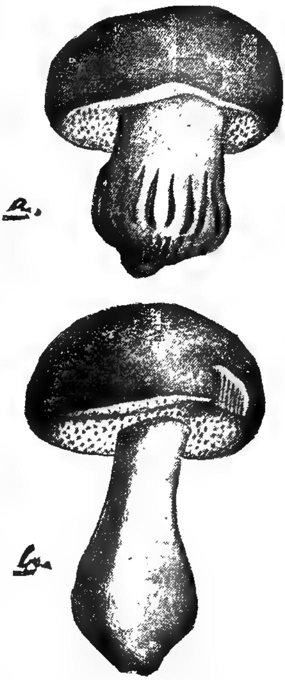


FIG. 6.—Cèpes. *a, Boletus bulbosus. b, Boletus edulis.* (After Dr. Taylor.)

The morille (Fig. 7), of which there are two edible varieties (*Morchella esculenta* and *M. nigra*), is a soft, fragile, and often semi-transparent mushroom of a grayish-black color, the outer surface of which presents a net-like appearance from numerous irregular cavaties. They are found in almost all soils, more particularly silicious ones, in the woods or along country roads, and are to be met with under several kinds of trees, as the oak, chestnut, ash, or elm, and sometimes also in hollow trees. They affect dry soils, and are better and more perfumed as they have absorbed less water, and should be gathered upon dry days, after the dew has evaporated. They are found in the spring and summer months, being at their best in the hot, dry days of July and August. The best are found in Périgord and around Agen. They may

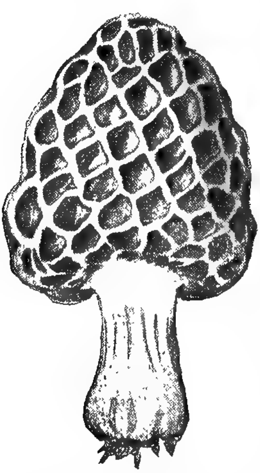


FIG. 7.—Morille. *Morchella esculenta.* (After Dr. Taylor.)

be eaten cooked when fresh, or preserved, and are rather dear, bringing from 5 to 10 or sometimes even 25 francs per kilogram, according to quality and season.

Up to 1874 the cultivation of morilles had not been attempted, principally on account of their short duration, but in that year an experiment in this direction by M. Geslin (see Journal d'Agriculture Pratique for 1874), who formed a bed composed of two-fifths earth in which morilles had grown, two-fifths street sweepings, and one-fifth decayed wood. The next year, from the first days of April up to the middle of July, he gathered 13½ kilograms of morilles from 3½ square meters of this bed. Both cèpes and morilles, preserved by Appert's process, were shown in the French section.

Truffles have long been held as a delicacy of the first order in France. The truffle (*Lycoperdon tuber* Lin.—*Tuber melanosporum* Vittadini, *T. cibarium*, Fig. 8) is found in all parts of France, but is best and most abundant in the old province of Périgord. It is also abundant in Guyenne, Provençe, Dauphiné, and other parts of the south of France, but in the north it is generally inferior in quality. Some kinds are also found in Algeria or in Italy.

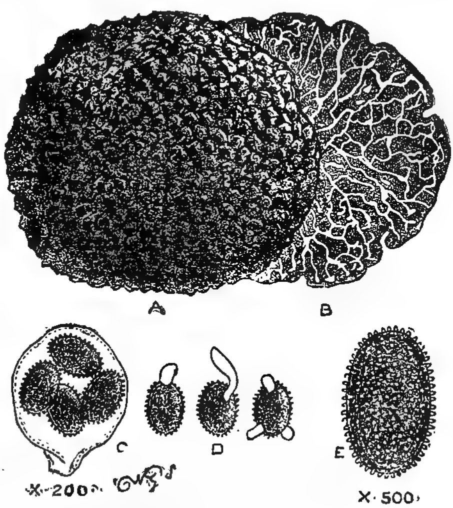


FIG. 8.—French Truffle. *Tuber Melanosporum.* A, exterior; B, section; C, *Asci* or transparent sporesacs. D E, magnified spores. (From Gardener's Chronicle.)

Various conjectures have been made as to the nature of the truffle, but it has finally been ascertained to be a mushroom of the subterranean type (*champignon hypogée*), of the order of the thecaphore. It is a curious fact that truffles are only found under the shelter of various trees, and never farther off than the branches of the tree extend. They are particularly found under two species of oak, the white oak, or *chêne pubescent* (*Quercus sessiliflora*) and the green oak, or *yeuse* (*Quercus ilex*), and it was formerly supposed that they would grow under such trees alone, but they have since also been found under about forty different sorts of trees, notably the hazel, hornbeam, beach, birch, linden, poplar, cedar, and even the black pine. A calcareous soil containing not less than 1 to 1½ per cent of carbonate of lime, and also the presence of the oxides of iron, seem to be essential to their development. A climate which is favorable to the growth of the vine is also favorable to the truffle. It is stated that grass will not

grow upon a truffle bed until the truffles are exhausted. When the trees become too old no further truffles are to be found.

There are about twenty enumerated varieties of the truffle in France, but only four of these are edible, or at least marketable. The most important is the violet, or *truffe de Périgord* (*Tuber melanosporum*). This is found in the southeastern parts of France, and especially in Périgord, the best localities being near Sorges and Mareuil (Dordogne) or near Sarlat. It also grows in Italy or in other parts of Europe, but has not yet been found in Great Britain. It ripens in the autumn and winter, being at its best in January and February, and is more often found under the white oak than under other trees, in groups of from 1 to 3 kilos, individual truffles weighing from 50 to 100 grammes. When fully ripe the flesh is black with a dark reddish or violet tinge, marbled with white lines, and is the most esteemed on account of its agreeable perfume and savor. The quantity varies in different years; thus in 1888 truffles were small and few in number. Generally to have a good harvest of truffles in the winter, the months from July to October must have been hot and moist. The truffle is found at various depths in the soil, from 1 to 50 centimeters (19½ inches), but generally at from 10 to 12 centimeters (4 to 5 inches). Those nearest the surface are the first to ripen.

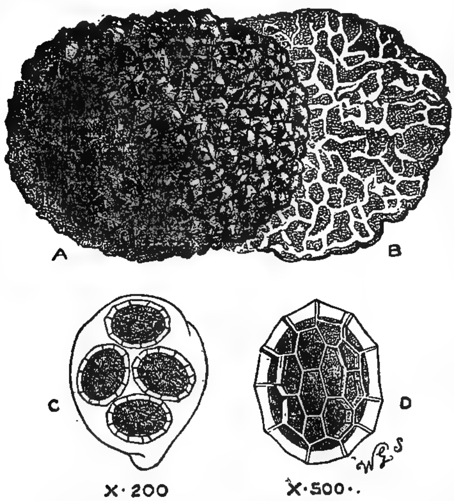


FIG. 9.—English Truffle. *Tuber æstivum*. A, exterior; B, section; C, *Asci*; D, magnified spore. (From Gardener's Chronicle.)

Other varieties are the winter truffle (*T. brumale*), which has a grayish flesh and a slightly musky or alliaceous odor, and is found in Périgord and the south of France and also in England. The summer truffle (*T. æstivum*, Fig. 9) is found in central and southern France, under oaks, beeches, hazles or birches, rarely under pine trees. It ripens from July until late autumn and has flesh of an ochrey or brown color marked with white irregular lines, and bearing a strong aromatic odor; it is less esteemed than the preceding. This variety is also found in some parts of Germany, and is the ordinary truffle of the English market, being quite common in that country. Finally there is the *truffe fouine* (*T. mesentericum*) found in central France, and not rare around Paris; it ripens in the autumn, and closely resembles the summer truffle, but has a grayish flesh and is but little sought for.

The Italian truffle (*T. magnatum*) (Fig. 10) has a smooth surface, often cracked, and of a pale ochrey brown color, sometimes shaded with red or green. The flesh is reddish black, or brown with yellow veins, and has a strong alliaceous odor. It grows in clayey soils under oaks, willows, or poplars.

Since truffles grow underground, without any visible exterior sign except the occasional breaking of the earth above them, recourse must be had to some method of detecting their presence. For this purpose dogs, usually small spaniels or poodles, are trained in some parts of France, but more generally swine are employed, the sow being preferred to the hog on account of her more acute sense of smell. A well-broken sow may sometimes sell for as much as 600 francs, and successive generations having thus been trained, there exists a race of truffling swine, as there does of hunting dogs.

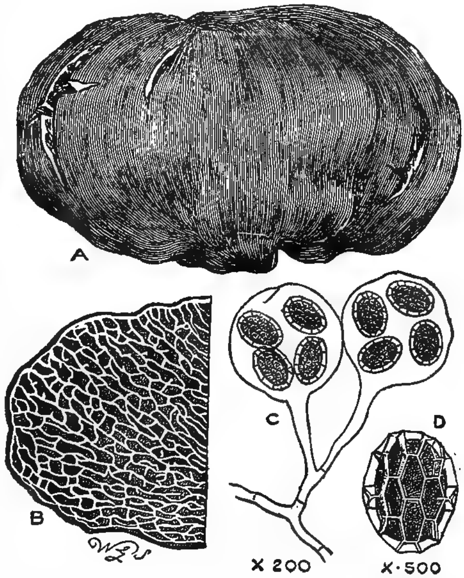


FIG. 10.—Italian Truffle. *Tuber magnatum*. A, exterior; B, section; C, *Asci;* D, magnified spore. (From Gardener's Chronicle.)

Many attempts have been made to cultivate the truffle, but they have been only partially successful. It is probable that complete success will never be obtained.

The production of truffles in France was in 1869 estimated at about 1,588,000 kilos, which at an average value of 10 francs the kilo would amount to 15,880,000 francs ($3,176,000), to be divided among fifty of the eighty-six departments of France. The exportation of truffles in 1856 was only 43,675 kilos; in 1880 this had increased to 201,554 kilos, since when the figures have fluctuated, being in 1885 only 131,699 kilos. Most of those exported go to England, then to Germany and Belgium, while Russia and the United States consume but very few. The exposition of truffles was a particularly fine one, there being ten exhibitors, some of whom showed truffles of exceptional size and quality; one house displayed truffles prepared in 1874.

Dried prunes form an important item in French commerce, and a large and handsome show of them was made.

The best of these are the well-known *prunes d'Ente*, some of which are of large size and splendid quality. Agen, Bordeaux, and Villeneuve-sur-Lot are the principal centers for the production of these.

The fruit generally used is the Agen or Ente plum, also called *datte violette*, a large oval plum of a violet color with very dark yellow flesh, and ripening in August. These are dried in appropriate ovens, the heat being carefully regulated, and never very high, and the fruit only used after it has attained perfect maturity. Sun-drying is customary in the south of France, but not for the best varieties. Another fine production is the *pruneau de Tours*, generally made from the St. Catherine plum, a medium-sized, oval, yellow, sweet fruit, ripening in September and October, and grown in the valley of the Loire. Other good varieties used for drying are the Reine-Claude, Damas de Tours, Perdrigon, and Quetsche. The Mirabelle, Île-Verte, Imperial white, and also the Reine-Claude are used for preserving. Less fine sorts of dried prunes were shown, intended for cooking or for distillation.

There was also a considerable show of olives. The olive is cultivated in Provence, Languedoc, and Rousillon, but the climate of northern and central France is too cold for it, and even in the southern provinces it is not yet fully acclimated. The fruit is gathered green, prepared by soaking for several days in an alkaline solution (weak caustic soda), and then preserved in strong brine, with or without spices, etc. The olive is more used for its oil than for preserving, but for this France can not compete with Italy or Spain. Olives are also grown in Algeria and Tunis.

Figs are extensively cultivated in France, especially along the Mediterranean, though some varieties grow well near Paris and along the Channel coast. They are often dried, but no samples of these were to be seen at the Exposition.

CEREALS.

The show of cereals naturally held a very prominent place in the agricultural exhibit, wheat being the most important, for France is, after the United States, the largest wheat-growing country of the world, India, Russia, and Austro-Hungary coming next in order.

During the ten years, 1875-'84, the average annual wheat crop of France was 100,726,074 hectoliters, and yet it often happens that the supply does not satisfy the demand and that wheat must be brought from abroad. From 1881 to 1886 the average annual yield per hectare was only 15 hectoliters, whereas an average of 17 hectoliters, corresponding to a total annual yield of 120,000,000, is necessary to obviate the purchasing of foreign wheat. With an average yield of 25 hectoliters France would have enough surplus wheat to supply the whole of England, in which country the annual average of bushels per acre is tending to decrease. In view of these facts the cereal show upon the Quai d'Orsay was considered as an encouraging one, much progress having been shown, particularly over that of the Exposition of 1878.

a, BORDEAUX WHEAT; *b*, PETANIELLE WHEAT; *c*, DATTEL WHEAT.

About thirty different varieties are used in France, most of which are of the class known as "tender wheats" (*blés tendres*), which may be autumn or spring wheats, bearded or not bearded. These are the most known, and they afford a very white flour with but little bran. Autumn or winter wheats are usually sown in France in September or October, or sometimes later, and they are generally used at from 80 to 120 kilograms per hectare in the drill, or at from 160 to 240 kilograms broadcast. A hectoliter of these wheats weighs from 75 to 80 kilograms, 77 kilograms being taken as a commercial mean. Spring wheats are generally sown in March, but sometimes in April or even in May, and must be sown thicker than autumn wheats. Bearded wheats are considered more hardy and as better resisting excessive cold or drought than beardless varieties, but the most hardy are generally local varieties, little appreciated elsewhere. The beard is found to present inconveniences in the management of the grain.

A custom prevails in France of sowing two or three varieties of wheat mixed together. The yield is generally greater than from the same amount of a single variety, but great care must be taken to use wheats ripening at about the same time. Wheat and rye are also sown together in the same way, the mixture being known as *méteil.* Some individual varieties of tender wheats may here be noticed.

Aleph.—Very productive, but not so successful as the Bergues or Flanders white wheat, from which it was derived; ripens late and does not resist diseases.

Bordeaux, rouge inversable.—This wheat was brought from the south of France after the war of 1870 and rapidly became a favorite because of its precocity and great productiveness, and its culture is still increasing. It is not easily thrown down by storms, though it is said to lose this quality if too heavily manured. Though an autumn wheat, it may be planted in January. It is especially replacing the Chidham wheats.

Chidham autumn wheat.—From 1854 to 1870 this supplanted all other autumn varieties, but it is now but little cultivated, as it has rarely given the harvest it used to, and is inferior to new varieties.

Chidham March white wheat is a little more delicate than the Saumur March wheat, but has been rivaling it of late years, and commands a better price in the market; very productive.

Chubb.—A very productive wheat, but must be sown early in the autumn; its grain is very heavy and its straw very stiff.

Dattel.—This is a new wheat, introduced in 1887, and is a cross between Prince Albert and red autumn Chidham, the latter of which it most resembles; it is an autumn wheat, but may be sown as late as January. It is very much appreciated and extensively cultivated, as it resists storms and gives very regular yields. A plant of Dattel wheat is illustrated, grown in the department of the Somme, consisting of 26 stalks derived from a single seed.

Hallett's "genealogical" wheat.—Maj. F. F. Hallett, of England, has occupied 30 years in investigating the crossing of wheats and other grains, and has produced some remarkable results, among which are the four varieties of wheat known as "goldendrop," "hunter," "nursery," and "Victoria," all much esteemed in France and Belgium.

Goldendrop.—This is a very hardy and productive wheat, and has a stiff, strong straw, growing ordinarily to the height of 1.30 to 1.50 meters and not easily lodged. It is much esteemed in northern France, and would be much cultivated were it not subject to what may be termed sun-scald (*échaudage.*) Its flour contains much gluten.

The *Hunter* is one of somewhat peculiar formation, it is prolific, but sensitive to the cold. M. Deconinck, of Arras, the agent of the Hallet wheats for France, who was also the introducer of the use of nitrate of soda into French and Belgian agriculture in 1869, exhibited a plant of this wheat comprising 27 heads, averaging 71 grains each, and showing a total of 1,846 grains from a single seed.

Kessingland.—A very good autumn wheat, giving a good yield of both grain and straw; the straw is stiff and very long and the head very large.

Lamed.—Introduced in 1887. It is a cross between Prince Albert and Noah wheats, is precocious and succeeds well in the Beauce district around Chartres, or wherever Noah and Bordeaux wheat are grown, but is not so generally successful as the Dattel.

Noah or *Île de Noé "blue" wheat* originates from southern Russia. It is precocious and may be sown as late as February or March. "Its boasted merits are disputed in the Brie district, yet, though little cultivated separately, it is often cultivated mixed."

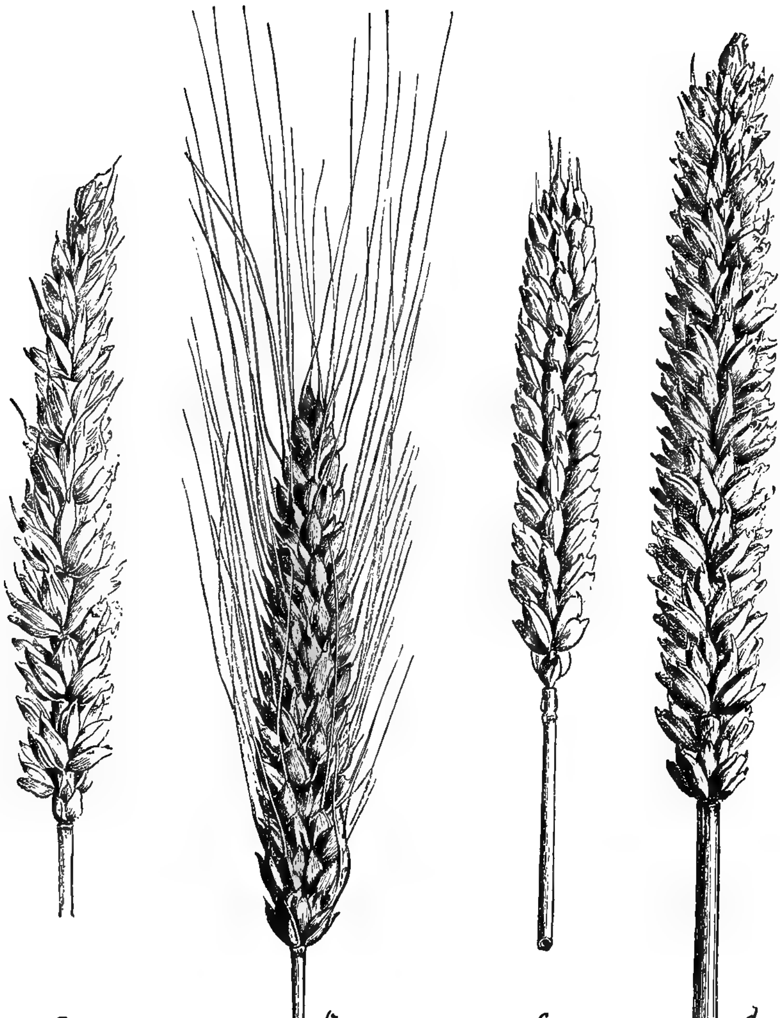
Nursery.—One of the original Hallett wheats. Its grain is of a uniform red; and its straw is abundant and often 2 meters long in rich soils. A single seed has given 55 heads averaging 68 grains each, or a total of 3,982 grains. It is a tardy grower and is planted early.

Prince Albert.—Moderately hardy and very productive; is planted early; straw very long.

Rieti wheat, introduced into France in 1887–1888, is in Italy what the Saumur wheat is in France, the variety most esteemed for making fine flour. It succeeds well in France, especially in the center and in the south, succeeding all the better since it is a bearded wheat. It is vigorous and resists diseases better than most wheats of foreign origin.

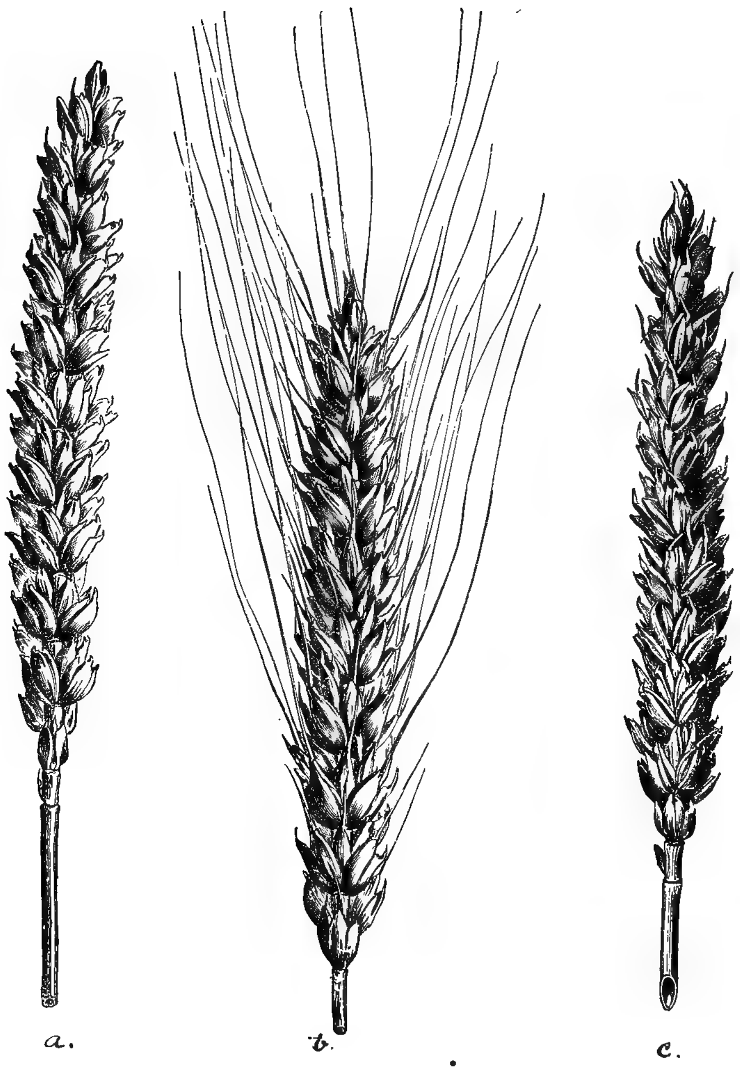
Roseau.—Precocious; its straw is short and very stiff, and so not easily lodged.

Rouselin is being tried by many growers who have been attracted by its precocity, the beauty of its grain, and the qualities of its straw.



a *b* *c* *d*

a, NOAH WHEAT; *b*, NEW BEARDED LARGE-GRAINED; *c*, SCHIREFF SQUAREHEAD; *d*, VICTORIA AUTUMN.



a, BORDIER WHEAT; b, NEW BEARDED LARGE-GRAINED WHEAT; c, LAMED WHEAT.

Saumur autumn or St. Laud gray wheat has gained ground within the last few years, and has given large harvests. Its grain is much sought for grinding, but the late spring frosts of 1888 were very unfavorable to it.

Saumur March wheat.—For forty years this variety has not ceased to be regarded as the most valuable of spring wheats, and is as valuable as most autumn wheats.

Schireff Scotch wheat gives good yield, and is hardy, withstanding cold of considerable duration. Its straw is very straight and stiff, and is one of the best resisters of storms. It succeeds well in moist soils, but best in clayey ones, and should not be planted later than the middle of November.

Schireff square-head.—This variety was introduced into France from Germany in 1884. It is never thrown down by storms, and has given very good results, but is subject to sun-scald, and its grain is too often poor in quality, so that its culture is not spreading. A single grain has produced 23 heads (Somme).

Standup.—An autumn wheat, but may be sown as late as January on account of its precocity. Resists storms; hence its name.

Victoria autumn white wheat.—The fourth of the Hallett wheats. It is very vigorous and productive, and ripens from ten to fifteen days earlier than the other Hallett wheats, but is sensitive to the cold and is easily lodged. A single seed has produced 36 heads averaging 50 grains each, or giving a total of 2,120 grains.

Victoria doré and *Victoria perlé* are two new varieties. 1888.

Besides the above, two new wheats have been issued this year, namely: *Bordier*, which is derived from the same cross as the Lamed, which it promises to equal in yield, while it surpasses it in beauty of grain; it is vigorous and resistant, regular, and moderately precocious. The other new variety is a bearded, large-grained wheat, not yet named, which ripens about 10 days sooner than most other wheats.

Among these "fine wheats" those most appreciated for flour are the Saumur, Chidham white, Dattel, and Hunter, next to which come the Aleph, Prince Albert, Schireff (French), Standup, Roseau, and Victoria.

After the tender wheats come the Poulards, which are generally of large grain and very hardy, and will grow in soils which are too moist for the finer wheats. Their grain contains more bran, and their flour is not so white, but they make up for this by their great productiveness. Their straw is hard and stiff, and they are generally sown in autumn. The Australian wheats and the Petanielles belong to this class.

Tender wheats are generally more cultivated in northern climates, whereas in warmer countries, as in the south of France, Algeria, and Tunis, the wheats are of what is known as the hard varieties

(*blés durs*). These are generally more rich in gluten and so more nutritious, and are mostly sown in the autumn. They are more adapted for the making of alimentary pastes (macaronis, semoules, etc.), than for flour.

Épeautres, or spelts, are wheats, the grain of which is not separated from its husk by threshing. They are very hardy and are suited to mountainous and cold countries, but the need of proper machinery for their manipulation prevents the extension they merit, for they give the whitest and best flour. On account of their husk they weigh less per hectoliter than other wheats, averaging 40 to 45 kilos. Sown broadcast they require only 170 kilos (400 liters) per hectare.

The 7,000,000 hectares which are annually cultivated with wheat in France do not yield sufficient for the wants of her people. But quality is also desirable, and many French millers are in the habit of using a certain proportion of foreign wheat in order to make up in their flour the supply of gluten wanting in the French wheat.

These considerations have led MM. Gatellier and L'Hôte to institute a series of investigations as to the conditions under which gluten is formed in the wheat grain, and what are the influences of soil, fertilizer, preceding crop, or variety of seed upon its formation.

Davy admitted that wheats in hot climates were richer in nitrogenous principles than those in temperate climates. Hermstœdt planted wheat upon one soil with various fertilizers, and observed that the most nitrogenous fertilizer gave the grain richest in gluten.

In the experiments of MM. Gatellier and L'Hote, Victoria wheat was planted on the same soil with the same fertilizer, but in three different states of rotation: 1st, after sugar beets; 2d, after oats which had succeeded lucern; 3d, after minette which had been manured with 30,000 kilos manure to the hectare.

The three crops were totally different from each other in appearance although derived from the same seed, and the handsomest sample was that grown after the sugar beet, the other two having longer grain of a grayish color.

Upon analysis these samples showed:

	Nitrogen.	Gluten.
	Per cent.	*Per cent.*
After beet, No. 1	1.45	9.06
After lucern, No. 2	1.61	10.06
After minette, No. 3	1.68	10.50

This proves that the handsomest sample after beet was the least rich in gluten; since the sugar is a plant which is very covetous of nitrogen, while both lucern and minette leave more nitrogen in the soil, the conclusion is that the richness of the soil in nitrogen in-

creases the richness of the wheat in gluten. Further experiments showed that it was possible to increase the gluten in wheat by means of appropriate fertilizers, the increase depending upon the proportion of nitrogen (in form of sulphate of ammonia) to phosphoric acid therein contained. There is also a difference between wheats in amounts of gluten. March wheats contain more than autumn wheats, the former averaging 14 per cent, the latter 9½ to 12 per cent only. There is no relation between the yield of a variety and its richness, and in this respect wheat does not resemble the sugar beet where the smaller roots may be the richer in sugar. It is possible, therefore, to cultivate wheat so as to obtain at once large yield in grain and richness in gluten. It has been found that English wheats, generally poor in gluten, become more glutinous when planted in the more nitrogenous soils of America or Australia, and at the same time their grain previously round or oval becomes elongated, this elongation being due to the greater proportion of gluten, which is situated toward the extremity of the grain. The conclusion of these experiments is that if wheat, which exhausts the nitrogen of the soil, is to be planted care must be taken to supply a fertilizer sufficiently nitrogenous, yet without an excess of nitrogen, which would subject the wheat to sun scald or weaken it so as to make it easily thrown down.

Care should also be taken to select wheats naturally rich in gluten.

These same scientists, with the aid of M. Schribaux, have tried interesting experiments upon the artificial crossings of wheats, and had, in the exhibit of the Department of Seine-et-Marne, a collection of thirty-five samples of new varieties of such crossed wheats produced upon their experiment fields at Meaux. The object in view was to obtain improved varieties by crossing wheats reputed to be productive with others less productive but of known good quality. For this purpose Shireff Square-head wheat was chosen as a basis and was successively crossed with Crépy, Bergues, Belotourka (bearded) Dattel (itself a cross of Prince Albert and Chidham wheats), and Hungarian (bearded); all these were successively used as male and female parents of the new crossed varieties. Out of 37 varieties produced it was found that 20 resembled the mother, 16 both mother and father, 1 resembled neither parent, and none resembled the male parent exclusively; the influence of the mother plant therefore predominates, and in those most resembling the mother there is generally increase in weight of grain. The finest cross obtained was from the Shireff (male) and Crépy (female).

Barley.—This grain succeeds best in light, warm soils, and grows well in almost all latitudes. In northern countries it is more often used for brewing, while in warm lands it is frequently used for horses (see Algeria). Prepared as meal it is everywhere used

for human food. Its dry straw is not good for fodder, but it is useful for litters. It is, however, a good green fodder, and in France is often planted for this purpose in mixture with other forage plants as rye or vetches, being cut before the head is formed.

The most important variety of barley in France is the *Chevalier*, which is especially esteemed for malting purposes. Its culture is steadily increasing and in certain departments it is replacing the common barley. It is vigorous, has a long straw, and is very productive, averaging 65 to 70 kilos to the hectoliter.

OATS.—This cereal is especially cultivated for its grain, not only for horses, but for all animals, and even for poultry. It is sometimes sown in February, but ordinarily in March or April, except winter oats, which are sown in September or October, or sometimes as late as January, and generally 125 to 175 kilos are sown to the hectare. The grain weighs about 50 kilos per hectoliter. About twenty varieties of it are grown in France, several of which may be mentioned as follows:

Abundance, a new and very productive variety.

Belgian winter black oats, of strong straw and heavy grain, giving a good yield of both and resisting frosts.

Brie or *Coulommiers black oats*, a short, black, heavy grain and very prolific.

California, a very vigorous grower, having a long thick straw which stands up well and is valuable. In good soils it gives an enormous yield.

Étampes early black, of short straw and almost as early as the Joanette.

Flanders yellow or Salines, "a good variety, which will not be much cultivated as long as the grain dealers of Paris persist in deprecating white or yellow oats." This is the most usual variety in northern France; it is very prolific and has a very long straw, which stands up well.

Georgia has a yellow, large, and heavy grain, with rather a hard husk, and a long, thick, soft straw; it is prolific and early and may be cut green to allow of a second crop.

Giant "à grappes," a new and very productive variety.

Houdan gray is prolific, gives a very regular yield, and is much esteemed in Central France.

Hungarian black, also called *Tartary* or *Oriental* oats. It has been much experimented with, but not much cultivated, as it is tardy and given to sun-scald and is hard to thresh. Its grain is generally thin and light, but becomes larger and better in good ground, while in poor land it is inferior to ordinary varieties.

Hungarian white oats, of mediocre quality, but succeeds better in the south than in the north of France. It does best in rich soils, but in poor ones it does better than black Hungarian and has a longer straw.

Joanette or *Chenille* oats.—"If its great precocity causes it to be sought under certain circumstances it is too subject to fall from its husk to be cultivated in large fields."

Polish, also called *Canadian* or *Merveilleuse*, little cultivated, but not without merit, as it is very productive and has a high, strong straw.

Provence winter oats, gray and of heavy grain, and is sown from September to February, but is little cultivated in northern France, as it is very sensitive to the cold.

Siberian early white, a variety of Georgia oats, of heavy grain and strong straw.

Rye.—Rye was but little shown at the Exposition. It is cultivated in France in soils which are too light or too little fertile for wheat, or, when fine straw is wanted, it may be sown in richer soils. The ordinary autumn rye, sown from August to October, is also frequently used as green fodder, on account of its precocity, and is the commonest as well as one of the best sorts of French rye.

Alpine or *Mountain* rye has a long, heavy head and is subject to dropping its grain, wherefore it is cut somewhat green. Its straw is fine, but shorter than that of the ordinary rye. It is a very productive variety and much esteemed in Dauphiné, but when planted in the plains it is subject to degeneration in the second or third generation. This name is also given to a variety of Sicilian rye.

St. John or *Multicaule* rye, so called from its being sown about June 24, or St. John's day, has a long and fine straw, but it is a late grower, though productive.

Saxon March rye has a fine grain and a very long and beautiful straw, and is more prolific in rich grain and straw than the ordinary March rye.

Maize.—Except among the seed collection of Monsieur Vilmorin-Andrieux et Cie. and in one or two of the collective exhibits, there was no noteworthy exhibit of maize in the French galleries, and in the show of this cereal France was entirely outdone by Servia and especially by Roumania, not to mention the United States. And yet maize was introduced a long time ago into France, is an important crop there, and has greatly increased in the last ten or fifteen years, especially since ensilage has come into general use. Maize is still used as human food in many parts of France, notably in Alsace and in the Haute-Saône, though nine-tenths of all the maize raised as grain is used for horses. Green corn, as we know it in America, is hardly ever eaten in France, and at no time during the Exposition did I see any of it among the exhibits of fresh vegetables upon the Trocadéro.

Maize occupies a large territory in Europe, notably in warm climates, as in Spain or Italy, and is abundant in northern Africa. Some very good maize was shown from Algeria. In France it is

seldom cultivated for grain north of a line extending from Nantes, at the mouth of the Loire, to Strasbourg, and even in this limit it does not always arrive at maturity. As a forage it has a wide field and extends over northern France, Belgium, and Germany, and even to England. It grows well in the silicious soils of Sologne, Berry, and Brittany, and very well in the "black soils" of Picardy and in the Belgian polders. In England fine fields have been obtained upon sandy soils by the utilization of sewage. In France maize is spoken of as "the giant plant of agriculture," as it gives the largest yield, both in grain and forage, of any of the cereals, growing sometimes 3 or 4 meters (9 feet 9 inches to 13 feet) in height and giving per hectare 60,000 to 150,000 kilos of gross weight (the whole plant). The crop which approaches it most nearly in yield is the sugar beet, which gives from 60,000 to 100,000 kilos gross weight. Italian ray grass and lucern, especially with irrigation, also give large yields, though less than maize. The French sow it in drills 0.66 meter (about 2 feet) apart, with a full meter between the lines, and they also sow it broadcast, using for the former method 14 to 20 kilos and for the latter 50 to 70 kilos per hectare.

When fecundation has taken place, and the pistils or silk has blackened, the summit of the plant is cut off just above the highest ear, and the grain is not gathered until fully ripe. The weight of the grain varies from 65 to 80 kilos per hectoliter, averaging from 70 to 75.

For forage or ensilage maize is generally sown broadcast but sometimes also in rows. It is cut when the tassels begin to appear. About 20 varieties of maize are used in France, the most important of which are as follows:

Auxonne, a yellow maize almost as early and productive as the Quarantaine. It attains a height of 1.50 to 1.80 meters and the ears are 12 to 15 centimeters long, each plant bearing two or three. It is much cultivated for poultry in Burgundy and in Bresse, and its meal is much appreciated.

Breille (white grain) grows rapidly with a thick stalk and very wide leaves, but it is much shorter than the Dent-de-cheval. It is precocious, and much used for forage.

Caragua giant maize (white grain). A very large and strong variety, and the principal one cultivated in France. Upon good soils and in favorable years it may sometimes attain the height of 4 meters (13 feet), and it is much the most productive for forage and ensilage. It does not always ripen in France, and therefore large quantities of it are imported from the United States to be used as seed.

The *Dent-de-cheval*, is a variety of the Caragua, and closely resembles it if it is not identical with it. The grain of both is white, large, long, flat, and often somewhat hollow on the summit. They

are rapid growers, but tardy in ripening, and give some of the best forage.

Cinquantino, taller and a little more tardy than the Auxonne and of a lighter yellow grain. Makes a good forage.

Cuzco, a white maize of Peruvian origin. Its grain is extremely large, tender, and very farinaceous. It grows to a height exceeding that of the Dent-de-cheval, and is the most productive in forage of all known maizes, but it is very slow to ripen, and in fact is only known to perfection in its native valley of Cuzco.

Japanese, a short variety only growing to the height of a meter, and never cultivated except as an ornamental plant.

King Philip, of brown yellow or reddish yellow grain, each plant having three or four stalks and may bear 6 or 10 ears. It is nearly as precocious and quite as productive as the Auxonne, and ripens well even to the north of Paris, and merits more general cultivation both for its grain and as a forage.

Landes, a handsome variety of white grain and moderate precocity, and much cultivated in southwestern France, grows about 1.50 meters high, bearing one or two ears to the stalk.

Large yellow, cultivated especially in the valley of the Loire, but does not ripen further north. Stalks 2 meters high. Its grain is remarkably large and very farinaceous, but it is not considered one of the best varieties. Makes good forage.

Motteaux, quite precocious, with an orange-colored grain, and one of the best to be cultivated in northern France for production of grain.

Perle, formerly much cultivated for forage, but now superseded.

Quarantaine, yellow grain. It is much the most precocious of all the maizes and attains its full height, which is over 1.20 meters, in from 40 to 45 days, whence its name. It is much cultivated in Franche-Comté and in Alsace, and ripens in August in the climate of Paris, but is of rather small grain and less productive than most other varieties.

A few varieties of sugar corn are cultivated in France, but more often for forage than for food. "Pop corn" seems to be entirely unknown there.

SORGHUM.—The only variety very extensively cultivated in France is the broom corn (*Holcus sorghum*), chiefly in the southern departments, where the grain is given to poultry or cattle and the straw used for brooms, etc.

The plant reaches 3 or 4 meters in height and has a red or brown seed, weighing 65 kilos to the hectoliter. It is sown in May, broadcast at about 32 to 40 kilos per hectare.

Sugar sorghum (*H. saccharatus*) is also employed in France, but not extensively; little sugar is made from it, its principal use being as a forage, either green or ensiled. The coloring matter of the

grain is also utilized. It does not ripen regularly except in southern France, where it is sown broadcast in April or May and harvested in August or September. It often gives 60,000 to 100,000 kilos gross weight per hectare. White or Douro sorghum is of larger and more nutritious grain than the other varieties, and is much used by the Arabs in Algeria and Tunis for the preparation of couscous, a sort of alimentary paste, somewhat like semoule, and one of the features of the Algerian exhibit.

MILLET (*Panicum*) is grown in central and southern France, the best white grain coming from St. Étienne. Its grain is principally used for poultry, singing birds, etc., while the whole plant is used for green forage. It is sown from April to June and must be cut before graining if for forage.

MOHA (*Germanicum*) is a species of millet, the Hungarian variety of which, originally introduced into France in 1815, is commonly used for forage. A more vigorous variety, from California, with larger leaves and more succulent stalks, is of later introduction, and when used as a green fodder is said to be more nourishing than maize. Poultry, especially young turkeys, eat its grain with avidity.

This plant withstands heat and drought, is easily affected by cold, and, therefore, is planted late. When it is to be used as a dry fodder moha may be dried like hay. If the weather is not too dry after its mowing this plant will grow, like grass, from the root, and thus affords an excellent pasturage for sheep.

BUCKWHEAT, *Sarrasin* (*Polygonum fagopyrum*), is quite common in France, and fine specimens were shown on the Quai d'Orsay. It is principally cultivated in Brittany, but also in Normandy and the Sologne district, and is used in many ways. The Bretons are very fond of it as a meal and make buckwheat cakes much more commonly than we do. Its grain is also given to poultry, pigeons, etc., and is esteemed for fattening swine, and is excellent for horses, but is said, somewhat doubtfully, to cause vertigo among horned cattle and sheep. It is a good green fodder, especially in mixtures, as with oats, millet, moha, or vetch. The ash of the stalk contains a large proportion of potash. and the plant itself is much used as a green fertilizer. Finally, its blossoms, as with us, furnish valuable bee forage. It is often sown as a second crop, after winter oats reaped in July. The old variety of black angular grain is now being superseded by a better one of a silvery gray color. There is also a Tartarian variety, stronger and less sensitive to cold, but ripening irregularly. When this variety is cultivated in Normandy its quality is much improved and somewhat resembles rye.

RICE is only cultivated in France in a few southern localities, as the marshes of the Camargue, or at certain points in Algeria, and does not succeed particularly well. None grown in France was shown at the Exposition.

CANARY SEED, *Alpiste* (*Phalaris canariensis*), of which there were several good exhibits, is considerably cultivated in France, not only for its seed, but as green forage for horses and cattle. It is sown from April to July, and cut three or four months later.

FORAGE PLANTS.—Besides the cereals, many specimens of hay, both from the ordinary grasses and from clover, lucern, and sainfoin, were exhibited, though no important addition to the list of French forage plants seems to have been made since 1878.

CLOVER.—Several varieties are cultivated in France, the most important being the *violet* and *incarnate* clovers. The former is more appreciated as a green forage than as hay, while the latter is more cultivated upon milk farms than upon larger farms where forage beets are grown.

These two clovers are considered as the best plants for sideration or green manure, the use of which has been extending in France of late years. The principle of this process consists, as is well known, in supplying nitrogen to the soil by the burying of green crops which are known to have the property of assimilating atmospheric nitrogen to a large degree. It is necessary that these clovers should be buried at the moment when they contain most nitrogen, which is as soon as they are in full flower. It is also necessary that their complete decomposition shall have taken place in the soil before they are fit to nourish the crop, generally wheat, for the benefit of which they have been buried.

M. le Vicomte d'Avène has given much attention to sideration upon his farm in the department of Seine-et-Marne, and has met with considerable success. Land of not particularly good quality being siderated with violet clover in 1887 gave 34 hectoliters of wheat to the hectare in 1888, while incarnate clover gave similar results. In one experiment where the clover had not fully decomposed in the ground there was a failure, and the wheat grains decayed without sprouting. If the first crop of clover must be mown and used for live stock, the second crop may be used for sideration upon condition of making up the deficit of nitrogen by the addition of about 100 kilos of nitrate of soda per hectare during the following spring.

LUCERN.—Although fields of it last nowadays only 3 years or so, lucern is still considered as an essentially ameliorating plant. It is worth more as an accumulator of nitrogen in the soil than as a product for sale or for consumption.

LUPULINE, or *Minette*, is used upon farms where many sheep are raised, and there takes the place of incarnate clover for cows.

SAINFOIN often furnishes a first crop as abundant as lucern, and the second crop, cut while in grain, is an important one. It is almost as valuable as incarnate clover, and does not cause flatulency in cattle, but is less valuable for plowing under than ordinary clover, and much less so than lucern. In an exhibit coming from Ste.

Menehould (Marne), honey was shown from bees allowed to feed upon Sainfoin.

TEOSINTE (*Euchlœna luxurians, Reana luxuriana*), which was introduced into the United States a few years since, is well known in Algeria and in the French colonies, where it gives excellent results as a forage plant. It grows luxuriantly in southern France but never flowers there.

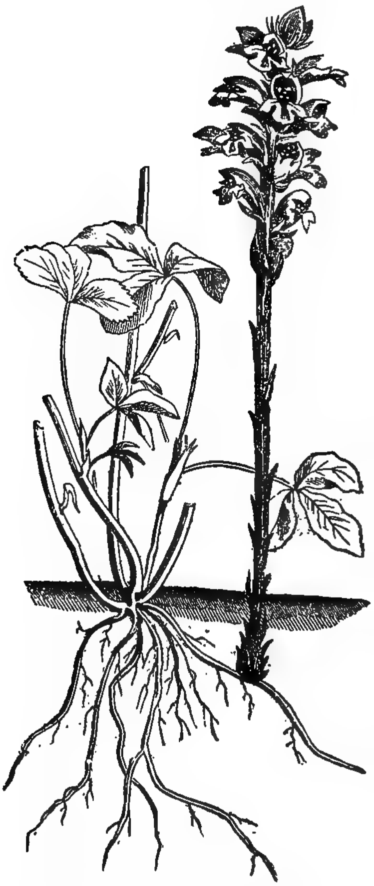


FIG. 11.—*Orobanche minor*. (From Journal d'Agriculture Pratique.)

A single seed of teosinte will, in a few months, produce a tuft 1 meter in diameter and 2 or 3 meters in height of stalk, the product of which will weigh 100 kilos when green. It should be employed as a green forage or for ensilage, as its thick, fleshy stalks will not allow of its being converted into hay. A single kilo of the seed is sufficient to sow a whole hectare. Unfortunately no sample of this plant was to be seen at the Exposition.

At the Agricultural Congress some notice was taken of one of two parasitic plants infesting lucern and similar crops, which it might be well to mention here.

An important parasite is the broom-rape or strangle-weed (*Orobanche minor*, Fig. 11), which develops upon many plants, especially upon the roots of clover, ordinarily in the second year of its growth; the plant grows yellow and dies, generally in patches of greater or less extent. This parasite multiplies by very fine seeds, of which prodigious quantities are produced by each plant, and which are easily carried by the wind, but are easily separated from clover seed by appropriate machines. The best way to exterminate this parasite is to omit the planting of clover for a longer or shorter period, replacing it by lucern, which is not so easily attacked. The same parasite attacks the carrot, while a larger variety attacks hemp and tobacco.

The cuscuta or dodder—a leafless, rootless, filiform, phanerogamic parasite—attacks clover and lucern, in France as it does with us, spreading rapidly and causing serious damage. The best protection

French farmers find against it is to insure the purity of the lucern or clover seed used, or to destroy, by cutting and burning, any patch appearing to be attacked. Sprinkling with a 5 per cent solution of sulphate of iron is also to be recommended. The creation of a station for the trial of seeds at the Agronomic Institute now permits the purity of seeds to be controlled in France as it has been for many years in Switzerland and Denmark.

Yields per hectare of certain cereals, etc,, in various departments of France, in 1888 *and* 1889, *as shown at the Exposition.*

I. WHEAT.

Year.	Variety.	Department.	Yield per hectare in— Grain.	Straw.	Remarks
			Kilos.	*Kilos.*	
1888..	Aleph	Meuse	1,900	....	1 hectare weighs 79 kilos.
1888..	......do	Nord	3,180	6.960	
1888..	do	Seine-et-Marne	3,500	8,900	
1888..	......do	....do	1,843	3,024	24.25 hectares, each 76 kilos. Ferme d'Arcy.
1888..	Australian	Meuse	3,200	....	1 hectoliter weighs 81 kilos.
1888..	......do	Seine-et-Marne	2,315	3,036	29.68 hectares, each 78 kilos. Ferme d'Arcy.
1888..	Bergues	Nord	3,338	7,525	
1888..	......do	Seine-et-Marne	4,200	7,500	
1888..	Bordeaux	Eure	*38	3,700	
1888..	......do	Eure-et-Loir	2,822	....	33.80 hectares, each 83.50 kilos.
1888..	......do	Meuse	3,100	....	1 hectoliter weighs 79.20 kilos.
1888..	......do	Seine-et-Marne	3,360	3,300	42 hectares, each 80 kilos.
1888..	......do	....do	2,066	2,844	26.15 hectares, each 79 kilos. Ferme d'Arcy.
1888..	...do	....do	2,800	7,600	
1889..	......do	Nord	3,917	6,800	Stalk 1.20 meters high.
1888..	Browick Prolific	....do	3,450	7,600	
1888..	......do	....do	3,760	7,358	
1888..	Cambridge	....do	3,850	6,530	
1889..	..... do	....do	3,850	7,389	Stalk 1.35 meters high.
1888..	Challenge	Pas-de-Calais	3,875	6,200	
1889..	......do	Nord	3,381	7,580	
1888..	Champion	Pas-de-Calais	3,866	7,134	
1888..	......do	Seine-et-Marne	4,200	8,100	
1888..	Chidham	Eure	3,300	4,400	
1888..	......do	Meuse	3,200	4,635	
1888..	......do	Nord	3,526	7,317	
1888..	......do	Pas-de-Calais	3,700	5,870	
1888..	Chidham, autumn, red.	Meuse	2,800	....	1 hectoliter weighs 80.70 kilos.
1888..	Chidham, autumn, white.	....do	2,500	....	1 hectoliter weighs 78.80 kilos.
1888..	Chidham	Seine-et-Marne	1,934	3,480	24.80 hectares, each 78 kilos. Ferme d'Arcy.
1888..	Chidham, Mch., red	....do	4,700	7,200	
1888..	Chidham, Mch., white	....do	4,700	9,000	
1888..	Chidham, Bigarré	....do	3,120	3,700	40 hectares, each 78 kilos.
1888..	Chubb	Eure	*33	4,300	
1888..	......do	Nord	3,845	7,389	
1888..	Crépi	Creuse	*18	2,800	
1888..	Dattel	Eure-et-Loir	3,078	....	38 hectares, each 81 kilos.
1888..	......do	Meuse	2,200		
1888..	......do	Pas-de-Calais	2,800	5,700	
1888..	......do	Seine-et-Marne	3,120	3,900	39 hectares, each 80 kilos.
1888..	..... do	....do	4,800	9,600	
1888..	......do	....do	2,184	3,360	28 hectares, each 78 kilos. Ferme d'Arcy.
1889..	......do	Nord	3,884	7,000	
1888..	......do	....do	4,250	7,250	
1888..	.....do	....do	*42.75	....	Stalk 1.20 meters high.
1887..	Goldendrop	Pas-de-Calais	5,100	....	
1888..	......do	Eure	*34	4,000	
1888..	......do	Haute-Saône	1,685	2,895	1 hectoliter weighs 76.615 kilos.
1888..	.....do	Meuse	3.000	....	1 hectoliter weighs 81.40 kilos.
1888..	......do	Nord	3,600	6,811	
1888..	......do	Pas-de-Calais	4,300	5,300	
1888..	......do	Sarthe	3,750	6,550	

* Hectoliter.

Yields per hectare of certain cereals, etc., in various departments of France, in 1888 and 1889, as shown at the Exposition—Continued.

I. WHEAT—Continued.

Year.	Variety.	Department.	Yield per hectare in— Grain.	Straw.	Remarks.
			Kilos.	*Kilos.*	
1888	Goldendrop	Seine-et-Marne	2,624	....	32 hectares, each 82 kilos.
1888	do	do	2,404	3,492	32.10 hectares, each 78 kilos. Ferme d'Arcy.
1889	do	Nord	3,288	6,930	Stalk 1.30 meters high.
1888	Hunter	do	3,184	6,601	
1888	do	Pas-de-Calais	4,037	6,200	
1888	do	Seine-et-Marne	3,040	3,800	38 hectares, each 80 kilos.
1888	Kissengland	Creuse	*26	3,550	
1888	do	Nord	3,412	7,088	
1888	do	do	3,905	6,830	
1888	do	Pas-de-Calais	4,000	6,333	
1888	do	do	4,260	6,100	
1888	do	Seine-et-Marne	3,040	....	Do.
1888	do	Nord	4,540	6,970	
1888	Larned	Creuse	*31	3,600	
1888	do	Eure-et-Loir	3,029	....	37.40 hectares, each 81 kilos.
1888	do	Meuse	3,200	....	1 hectoliter weighs 80 kilos.
1888	do	Nord	3,855	7,149	
1888	do	Seine-et-Marne	1,946	2,676	25.6 hectares, each 78 kilos. Ferme d'Arcy.
1888	Noah, "blue"	Creuse	*18	2,900	
1888	do	Eure-et-Loir	2,460	....	30 hectares, each 82 kilos.
1888	do	Seine-et-Marne	4,500	7,800	
1888	Nursery	Eure	*32	3,800	
1888	do	Pas-de-Calais	2,200	6,000	
1889	do	Nord	3,874	8,190	
1888	do	do	3,932	8,070	
1888	Orchies	do	3,400	7,744	
1889	do	Pas-de-Calais	*38	....	
1888	Pétanielle, black	do	3,840	6,250	
1888	Pétanielle, white	do	3,900	6,850	
1888	do	Meuse	2,300	....	1 hectoliter weighs 77.40 kilos.
1888	Poulard, Australian	Creuse	*22	3,960	
1888	do	Nord	4,681	8,220	
1888	Prince Albert	Eure	*30	4,600	
1888	do	Meuse	3,200	....	1 hectoliter weighs 81 kilos.
1888	do	Nord	3,980	8,400	
1888	do	Pas-de-Calais	4,080	6,400	
1888	do	Seine-et-Marne	2,370	....	30 hectares, each 79 kilos.
1889	do	Nord	3,738	7,910	
1888	Roseau	Creuse	*23	3,260	
1888	do	Nord	3,720	7,166	
1888	do	Seine-et-Marne	2,430	....	30 hectares, each 81 kilos.
1888	do	do	2,020	3,108	25.90 hectares, each 78 kilos. Ferme d'Arcy.
1888	Rough-Chaff	Pas-de-Calais	3,900	6,300	
1888	Saumur	Creuse	*20	3,300	Sown in March.
1888	do	do	*20	3,300	Sown in October.
1888	do	Seine-et-Marne	3,100	6,200	
1889	do	Pas-de-Calais	*35	....	
1888	Schireff	Haute-Saône	900	1,600	12.35 hectares, each 72.912 kilos.
1888	do	Pas-de-Calais	4,460	6,100	
1888	do	Seine-et-Marne	3,318	4,200	42 hectares, each 79 kilos.
1888	do	do	2,737	4,248	36.01 hectares, each 76 kilos. Ferme d'Arcy.
1888	do	do	5,200	8,000	
1888	Schireff, Danish, red	Eure	*40	4,100	
1888	do	Nord	4,200	7,420	
1888	Schireff, French, white	do	3,900	7,384	
1888	Schireff, Scotch, red	do	4,650	7,536	
1888	do	Pas-de-Calais	4,740	7,480	
1888	Schireff, square-head	do	3,700	....	
1888	do	Meuse	3,500	....	1 hectoliter weighs 81.50 kilos.
1889	Schireff	Nord	4,467	8,060	
1888	Scholley	do	4,765	7,915	
1888	Six-row	Pas-de-Calais	4,080	6,300	
1888	Square-head	Nord	3,600	6,800	
1888	Square-head, Norfolk	Pas-de-Calais	2,964	6,100	
1888	do	do	3,600	7,000	
1888	Square-head, Scotch	Sarthe	3,850	5,750	
1889	Standup	Nord	2,900	5,750	
1889	do	do	4,110	6,448	
1888	Trump	Pas-de-Calais	3,280	3,700	

* Hectoliter.

Yields per hectare of certain cereals etc., in various departments of France, in 1888 *and* 1889, *as shown at the Exposition*—Continued.

I. WHEAT—Continued.

Year.	Variety.	Department.	Yield per hectare in— Grain.	Straw.	Remarks.
			Kilos.	*Kilos.*	
1888..	Victoria	Creuse	*16	3,135	
1888..	......do	Meuse	3,200	....	1 hectoliter weighs 80 kilos.
1888..	......do	Nord	3,704	7,636	
1888..	......do	Seine-et-Marne	2,964	4,000	39.5 hectares, each 76 kilos.
1888..	......do	....do	2,320	1,952	29 hectares, each 80 kilos.
1888..	......do	....do	1,955	3,528	25.72 hectares, each 76 kilos. Ferme d'Arcy.
1889..	.....do	Nord	3,295	7,740	

II. OATS.

Year.	Variety.	Department.	Grain.	Straw.	Remarks.
1888..	Abundance	Pas-de-Calais	2,700	4,000	
1888..	....do	....do	2,900	4,200	
1888..	Beauce, gray	Seine-et-Marne	2,708	2,844	54.17 hectares, each 50 kilos. Ferme d'Arcy.
1888..	Bretagne, prolific	....do	3,200	6,600	
1888..	Bretagne, winter	....do	4,200	6,700	
1888..	Brie, black	Meuse	4,500	....	1 hectoliter weighs 52.50 kilos.
1888..	......do	Nord	3,074	4,524	
1888..	......do	Pas-de-Calais	2,600	4,000	
1888..	......do	Seine-et-Marne	2,324	2,712	46.48 hectares, each 50 kilos. Ferme d'Arcy.
1888..	......do	....do	2,900	8,200	
1888..	California, black	Pas-de-Calais	2,500	3,800	
1888..	California, prolific	Meuse	5,800	....	1 hectoliter weighs 49.20 kilos.
1888..	Canadian, black	Seine-et-Marne	*62	....	
1888..	Canadian, Hallet's	Pas-de-Calais	2,800	3,600	
1888..	Canadian, white	....do	2,800	3,600	
1888..	Coulommiers, black	Seine-et-Marne	2,600	3,200	52 hectares, each 50 kilos.
1888..	......do	....do	8,280	3,200	92 hectares, each 90 kilos.
1888..	Étampes, early	....do	3,700	6,600	
1888..	......do	Pas-de-Calais	2,400	2,800	
1888..	Flanders, yellow	....do	3,637	5,121	
1888..	......do	Meuse	5,200	....	1 hectoliter weighs 45.75 kilos.
1888..	Giant "à grappes"	....do	5,200	....	1 hectoliter weighs 48 kilos.
1888..	.....do	Pas-de-Calais	4,520	5,680	
1888..	Groningen	....do	*75	4,600	
1888..	Holland, white	....do	2,800	4,200	
1888..	Houdan, gray	Seine-et-Marne	8,918	3,200	98 hectares, each 91 kilos.
1888..	......do	....do	3,900	6,800	
1888..	......do	Meuse	4,200	....	1 hectoliter weighs 48.60 kilos.
1888..	Hungarian, black	Pas-de-Calais	2,000	3,800	
1888..	Hungarian, "à grappes."	Seine-et-Marne	8,370	3,000	93 hectares, each 90 kilos.
1888..	Polish	Meuse	4,500	....	1 hectoliter weighs 47 kilos.
1888..	......do	Seine-et-Marne	2,697	3,132	50.88 hectares, each 53 kilos. Ferme d'Arcy.
1888..	Probstei	Pas-de-Calais	3,800	4,400	
1888..	Salmes, yellow	....do	2,800	3,600	
1888..	Spring, white	Seine-et-Marne	8,928	3,300	96 hectares, each 93 kilos.
1888..	Spring, black	....do	2,250	....	45 hectares, each 50 kilos.
1888..	Swedish	Nord	3,250	5,400	
1888..	Tartarian, Hallet	Pas-de-Calais	2,000	3,500	
1888..	Winter, black	Seine-et-Marne	2,300	....	46 hectares, each 50 kilos.

III. BARLEY.

Year.	Variety.	Department.	Grain.	Straw.	Remarks.
1888..	Chevalier	Pas-de-Calais	2,200	3,100	
1888..	......do	....do	3,300	3,700	
1888..	Beauce	....do	*45	3,000	
1888..	Crimean, nue	....do	3,289	4,780	
1888..	Escourgeon, chaud	....do	4,400	....	
1888..	Escourgeon, froid	....do	4,700	....	
1888..	Moravian	....do	2,200	3,100	
1888..	Orgette	....do	2,600	3,400	
1888..	Riz-éventail	....do	1,800	2,400	
1888..	......do	....do	3,248	4,624	
1888..	Six-row	....do	3,658	6,744	

* Hectoliter.

NOTE.—1 hectoliter = 2.8375 United States bushels. 1 hectare = 2.4710 acres. Therefore 1 hectoliter per hectare is equivalent to 1.148 bushels per acre.

Yields per hectare of certain cereals, etc., in various departments of France, in 1888 and 1889, as shown at the Exposition—Continued.

IV. FORAGE-BEETS.

Year.	Variety.	Department.	Weight per hectare.	Sugar per deciliter juice.
			Kilos.	*Grams.*
1888..	Blanche de Pologne	Nord	59,000	....
1888..	German, long	....do	80 to 100,000	....
1888..	Mammoth	....do	80 to 100,000	....
1888..	Rose Giant	....do	90 to 100,000	....
1888..	Rose Lemaire	....do	35 to 50,000	....
1888..	White Giant	....do	90 to 100,000	....
1888..	Yellow Hesbaye	....do	35 to 40,000	....
1888..	Yellow Orvide des Banes	....do	90 to 100,000	....
1888..	Not specified	Pas-de-Calais	40,000	14.55
1888..	......do	....do	40,000	18.00
1888..	......do	...do	43,000	16 to 18

V. POTATOES.

[M. Paul Genay, Bellence, Meurthe-et-Moselle.]

Year.	Variety.	Time of ripening.	Weight of root per hectare.	Dry starch.	Starch per hectare.
			Kilos.	*Per cent.*	*Kilos.*
1888	Blanchard	Middle of August	13,926	12.00	1,671
1888..	Boursier, or Rickmaker	Second half of August	19,825	14.00	2,770
1888..	Canada Red	First half of September	14,188	15.50	2,200
18:8..	Canada White	Second half of September	29,700	12.50	3,712
1888..	Chardon	First half of October	17,355	11.10	1,920
1888..	Charlotte	End of October	15,400	15.70	2,471
1888..	Cherusker	......do	24,660	16.70	4,108
1888..	Early Regent	Middle of August	30,825	12.80	1,825
1888..	Early Rose	......do	13,695	11.80	1,616
1888..	Gross Kurfürst	End of October	19,536	15.00	2,930
1888..	Idaho	First half of September	21,780	11.70	2,548
1888..	Imperator, or Richter	End of October	17,345	17.60	3,044
1888..	Institut de Beauvais	First half of September	28,380	11.80	3,348
1888..	Jaune ronde hâtif	Middle of August	10,263	14.00	1,436
1888..	Jeaucé, or Jeuxe	First half of October	14,685	12.50	1,825
1888..	Juno	End of October	22,615	16.70	3,774
1888..	Kornblum	......do	24,420	17.30	4,221
1888..	Lapstone "Caillou blanc"	First half of September	12,870	11.10	1,428
1888..	Magnum Bonum	First half of October	25,080	15.20	3,800
1888..	Merveille d'Amérique	Second half of September	18,645	15.00	2,790
1888..	Odin	End of October	22,935	17.80	4,076
1888..	Reiskinned	......do	21,285	13.30	2,832
1888..	Rosalie	First half of September	18,480	14.70	2,705
1888..	Seguin	......do	16,665	15.00	2,500

VI. MISCELLANEOUS.

Year.	Variety.	Department.	Yield per hectare.		Remarks.
			Grain.	Straw.	
			Kilos.	*Kilos.*	
1888..	Beets for forage	Seine-et-Marne	4,500	....	
1888..	Beets for seed	Pas-de-Calais	1,275	....	
1888..	Buckwheat	Cher	*18	....	
1888..	......do	....do	1,440	....	1 hectoliter weighs 72 kilos.
1888..	Clover, hybrid	Seine-et-Marne	3,800	....	
1888.	Clover, Incarnate	....do	3,600	....	Ferme d'Arcy.
1889..	......do	....do	3,700	....	Do.
1888..	Clover, Violet	.... do	3,600	2,000	First and second crops, respectively.
1888..	Féverolles	Pas-de-Calais	3,500	4,000	Seed and straw, respectively.
1888..	......do	....do	3,245	3,500	Do.
1888..	Féverolles de Picardie.	....do	2,884	4,127	Do.

* Hectoliter.

Yields per hectare of certain cereals, etc., in various departments of France, in 1888 and 1889, as shown at the Exposition—Continued.

VI. MISCELLANEOUS—Continued.

Year.	Variety.	Department.	Yield per hectare.		Remarks.
			Grain.	Straw.	
			Kilos.	*Kilos.*	
1888..	Féverolles d'Orchies	....do	2,900	......	Seed.
1888..	Fèves de Salines	....do	3,100	....	Do.
1888..	Flax	....do	1,050	4,700	Grain and straw, respectively.
1888..	Flax de Salines	....do	3,100	....	Grain.
1888..	......do	....do	1,600	4,800	Grain and straw, respectively.
1887..	Flax from Riga seed	....do	700	4,860	Do.
1889..	Hay	Seine-et Marne	6,300	....	Ferme d'Arcy.
1888..	Lucern	....do	3,500	1,800	First and second crops, respectively.
1889..	Lucern, first year	....do	23,760	....	Ferme d'Arcy.
1889..	Lucern, third year	....do	33,600	....	Do.
1889..	Lupuline	....do	25,800	....	Do.
1888..	Oeillet	Pas-de-Calais	1,760	4,500	Seed and straw, respectively.
1888..	Rye	Cher	1,008	....	14 hectares grain, each 72 kilos.
1888..	......do	....do	1,314	....	18 hectares grain, each 73 kilos.
1888..	......do	Haute-Saône	*16	1,370	Grain and straw, respectively.
1888.	Rye, March	Pas-de-Calais	2,500	4,200	Do.
1888..	Rye, Autumn	....do	2,700	6,000	Do.
1888..	Vetches	Seine-et-Marne	4,200	....	Seed.
1888..	Potatoes	Cher	10,800	....	180 hectoliters, each 60 kilos.
1888..	......do	....do	12,000	....	200 hectoliters, each 60 kilos.
1888..	......do	....do	15,000	....	250 hectoliters, each 60 kilos.
1888..	Australian white straw wheat.	Seine-et-Marne	2,000	5,000	
1888..	Australian red straw wheat.	Pas-de-Calais	1,800	4,500	
1888..	Velvet wheat	... do	2,730	5,600	
1888..	Arras oats	....do	*67	....	
1888..	Flandres-Salines oats	Seine-et-Marne	*57	....	
1888..	Tartarian oats	Pas-de-Calais	*70	....	

* Hectoliter.

VEGETABLES.

These were shown at the Exposition in three different ways. First, several fine exhibits of potatoes and also several of sugar beets, with their products in all stages, were shown among the collective exhibits in the agricultural galleries; tables of the yields of these, as set forth by the explanatory cards, will be found with those of cereals. In addition there were numerous collections of dried farinaceous vegetables and of various roots included in the collective exhibits of Class 74. Secondly, the seedsmen's exhibits contained every variety of farinaceous vegetable known in France, with many other seeds of grains, vegetables, fruits, grasses, and even those of forest trees, together with catalogues and descriptive pamphlets, and wax or plaster models of vegetables or fruits. Thirdly, during the 26 weeks that the Exposition was open, eleven competitive shows of vegetables were held under Class 80 upon the Trocadéro. These shows, generally lasting a week at a time, comprised vegetables of almost every known description, freshly gathered and therefore shown at their proper seasons, and most tastefully arranged upon long low beds of earth under open tents, the whole making a most notable display. (See Frontispiece, Plate v.)

The cultivation of the potato has long been of extreme importance in France and is constantly acquiring further development, as

not only is the potato extensively used for food among all classes of society, but it also finds application for the nourishment of animals and is used in starch-making or in distillation. In 1879 potatoes were planted upon 1,250,000 hectares in France, and the harvest amounted to 80,000,000 quintals; in 1888 these figures had increased to 1,500,000 hectares, producing 115,000,000 quintals; yet this culture is not what it might be, and, although during the last ten years the average yield has risen from 55 to 75 quintals per hectare, the latter figure is much below what it ought to be; in certain rare cases 200 and even 300 quintals have been produced upon French fields, although in many foreign districts such would be considered as only the normal yield. It is to be hoped, however, from recent researches, that such large yields may yet be regularly obtained in France.

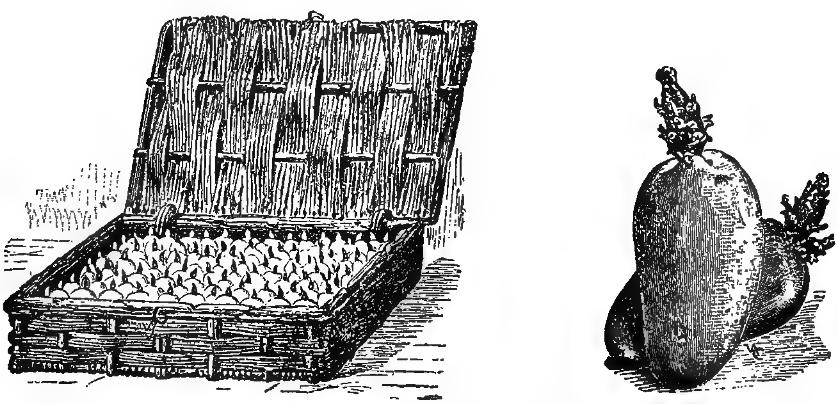


FIG. 12.—The Marjolin Potato. as sold ready germinated. (From Vilmorin).

The varieties of potato cultivated in France are generally of medium quality and do not exceed 13 to 14 per cent in starch; in fact they have been chosen not so much for their starch-making properties as for their resistance to the potato disease. Chemical fertilizers have hitherto not been much used, but in all probability their adoption in the future, together with improved methods of cultivation, will bring about better results.

Over fifty varieties of potato were shown at the Exposition, most of which were grown in kitchen or market gardens and gathered for consumption. The principal varieties were as follows:

The *Marjolin* or *Kidney Potato*, a very old variety, and the best for cultivation under glass on account of its low stature and the compact way in which its tubers grow together. A custom prevails of selling these potatoes for planting already germinated (Fig. 11). It is a very early variety.

Royal Ash-leaved Kidney resembles the Marjolin, but is less adapted for forcing. Of English origin and quite precocious.

Victor, also of English origin. It has perfectly yellow flesh, a point which seems to be appreciated by the French. As precocious as the Marjolin, if not more so. All these three varieties are excellent potatoes.

Joseph Rigault, new in 1885; precocious and of yellow flesh.

Lapstone, half early. It is perfect in form and smooth and pale of skin, but has the curious property of becoming violet-colored on exposure to light. It is a good summer potato and its culture is increasing in the south of France.

Marjolin Têtard, a particularly large and fine variety, but not always giving a large yield.

Quarantaine de Noisy, Holland, or *Late Marjolin.* This is, of all potatoes, the one most cultivated around Paris, and is sold at the Halles Centrales from August until the spring. It has replaced the old Holland yellow potato, killed off some years since by the potato disease. It keeps perfectly well throughout the winter.

Snowflake, a most beautiful potato of American origin; delicate and easily subject to the potato disease, and so limited in use.

Magnum Bonum, large, vigorous, and productive, but not very early; not liked by the Parisians on account of the pale color of its flesh. It strongly resists the attack of the potato disease.

Kidney Red, a good summer variety, of yellow farinaceous flesh.

Early Rose, the longest known and one of the best varieties of American origin in France. Precocious and prolific, but requires rather a dry soil for perfect qualities. Does not keep well.

"*Pousse-debout,*" essentially a Parisian variety and rarely to be found far from the environs of the city.

Violet-Kidney, Quarantaine Violette, a garden variety, early, yet of slow development, so that it keeps well, making a good winter potato.

Saucisse, probably the potato of which the greatest quantity is consumed at Paris, and for sale there from November until June, seeming to improve in quality as the season advances. Very slow to germinate.

Vitelotte or "*Mille-z-yeux,*" a long, thin potato with many eyes, which are deeply sunk, giving it a very curious appearance.

Blanchard, early, vigorous and very productive; keeps well.

Violet Round, much cultivated about Paris, and a very good winter potato; flesh yellow and very farinaceous.

La Bonne Wilhelmine, one of the oldest and best French varieties. It is not cultivated around Paris, but in Provence. Small in size, but good.

Yellow Round, a subvariety of the Chave, and somewhat earlier than this; one of the best of the commonest potatoes.

Modèle, a potato of almost spherical form, pale flesh and ordinary quality, but presenting two peculiarities, namely, of resisting the potato disease better than any other variety, and of not germinating until the moment of planting.

Séguin or *Lesquin*, originates from the dèpartment du Nord and is vigorous and of good yield ; germinates slowly and keeps well.

Holland Red resembles the kidney red, but is less early and more productive ; of very ancient race, but has lost none of its qualities.

Bresee's Prolific closely resembles the Early Rose, without its failings.

La Négresse or *Cetewayo*, a peculiar potato of flesh, so dark a violet that it appears almost black. It has been used dishonestly to imitate the truffle.

Several varieties of potato are cultivated almost exclusively for forage, and to this end quality is not so much needed as large yield and economy and ease of gathering. The principal are as follows:

The *Chave* or *Shaw* potato has been cultivated in France for about 80 years, and is one of the best for forage. It ripens in August and is somewhat liable to the potato disease.

Chardon, formerly much preferred, but now not so great a favorite. It is tardy, but resists the disease and besides its use for forage is sometimes brought to market when other potatoes fail.

Jeancé, *Jeuxy*, or *Vosgienne*, one of the hardiest and most productive varieties, and grown in the Vosges and in the north of France. It is very farinaceous, and is much used for starch-making.

Institut de Beauvais, introduced some three or four years ago. It is half early, enormously productive and one of the best for cattle. It closely resembles the American Idaho potato.

American Marvel, very vigorous and productive, and essentially a forage potato, though sometimes eaten and used in industries.

The alimentary qualities depend greatly upon the soil in which they are grown. Thus potatoes of great yield like the above are also very good for food when grown in the clayey soil, with calcareous sub-soil, of the Beauce, or in the shelly sands of Brittany, or the volcanic soils of Auvergne.

Finally, the varieties of potato most cultivated for industrial purposes are: The *Farineuse*, or *Red-skin Flour-ball*, a coarse but very farinaceous variety, rather late, but productive and resisting disease: and the *Imperator*, vigorous and farinaceous, which, in Germany, is said to have yielded 30,000 kilos to the hectare, the root containing 20 per cent of starch. These results have been equally obtained in France. Potatoes are variously cultivated in France, the most ordinary way being, as with us, simple planting of the tubers, which, however, are sometimes germinated beforehand ; they are planted about the first of April, care being taken to avoid late frosts. New potatoes generally appear in Paris markets toward the end of May, though those from the south or from Algeria arrive sooner. Potatoes are also forced under glass bells, being planted successively from January to March, and in this way the Marjolin or Victor are ready for the market 50 to 60 days after planting. Almost as good a yield

may be had by planting in November or December, so that the stalks arrive at two-thirds their height before they are destroyed by the frost, and then covering the ground with straw through the winter. Planting from seed is also resorted to. New varieties of potato are the *Canada*, introduced into France in 1887–1888, which is vigorous, rather early, and very prolific: also the *International*, which has a certain reputation along the French coast and is much used for exportation, but is too pale for Parisian taste. In 1889 three new varieties appeared: the *Hermann*, very prolific, rich in farinaceous matter and strongly resistant to disease, but a tardy grower: the *Pasteur*, a fine yellow variety, and the *Rosalie*, also very productive farinaceous and resistant.

SWEET POTATOES (*Patates*) were shown in one or two French exhibits and also from Algeria. Although more properly belonging to a warm climate, they may with a little care be cultivated around Paris, the principal difficulty being in keeping the tubercles until time for planting in early spring. They are gathered in September.

LEGUMINOUS PLANTS are extensively grown in France, and several large exhibits of them were made, both in the dried state on the Quay and freshly gathered, or even growing, upon the Trocadéro. Among these the bean (*Phaseolus vulgaris*) occupies the most important place. This vegetable, originating in South America, has during four centuries of cultivation developed more varieties than any other ordinary kitchen-garden plant, and a great many of these were upon exhibition. One house, that of Forgeot et Cie, showed sixty-five varieties in the collective exposition of the département de l'Aube, as well as forty-six of peas.

The culture of the bean is easy; around Paris it is planted in light soils, precocious varieties being planted about April 30, but most varieties not until the latter part of May, the planting being continued up to about August 10. String beans (*haricots verts*) are much appreciated by the French and are cultivated also under glass from the middle of January to the end of March. Both climbing and dwarf beans are grown in France, some of the principal varieties being worthy of mention as follows:

The *Soissons*, a large, white, climbing bean of superior quality, with a hard parchment-like pod; a red variety is also known. Soissons has long been celebrated for its beans.

The *Prague*, of various colors, the *Algerian* or *black butter* bean, the *Intestin* and *Prédome*, are all climbing varieties, with soft or edible pods.

Among the dwarf beans are the *Bagnolet* or *Swiss gray*, the *Swiss red* and the *Soissons dwarf*, much grown around Paris, especially to be consumed as string beans. These are hardy and vigorous, but somewhat late in development and are best suited to open field culture. A new variety (1888) is the *Bagnolet vert*. The *Belgian*

black bean is a very precocious variety, and the one which is most used for forcing.

The *Flageolets*, as the *Chevrier*, the *Merveille de France* and the new *Roi des Verts*, are especially used for conservation or for drying. When the pods are still green they are gathered and dried in the shade, in the open air, the seed thus preserving its green color.

The *Spanish climbing bean* (*P. multiflorus*) although much cultivated for ornament, is frequently used as a vegetable, especially in the green state. The *Lima bean* (*P. lunatus*) a very slow grower, is more suited to warm countries, and does not fully develop at Paris ; a variety of this, the *Sieva*, is less tardy.

The *Dolique bean* (*Dolichos*) also ripens with difficulty at Paris, but does well in Provence ; a variety, the *Asparagus* bean, with an extraordinarily long pod, ripens more easily. Other new varieties of bean (1887–1888) are the improved dwarf *Barbés* and the *Coco-tricolor*, both well suited to the south of France and to Algeria, the latter being a very prolific and precocious climber ; also the dwarf *Fleuriel* and the improved dwarf *Valentin*, this last being of American origin and a very early grower.

Fèves (*Faba vulgaris*) of which there are several varieties, have long been known in France, and are extensively cultivated, the principal sorts grown being the *Fève de Marais* and the *Windsor*, both of English origin. This crop is but little exhausting to the soil and is often planted in order to prepare clayey lands for wheat-bearing ; it is also one of the best of green fertilizers, a dwarf variety, the *Fèverolle*, being generally used for this purpose. Fèves are planted from February to the end of April, being gathered from May to August, and eaten green or fully ripe.

PEAS (*Pisum sativum*) were almost as extensively shown as beans, and are very widely cultivated in France. They are generally sown in good, light soils ; and as often as possible in newly broken or in fallow lands ; they are not manured, experience showing that fertilizers tend to make the vine too vigorous, producing stalks at the expense of the fruit. For the production of green peas, very popular in France, sowing takes place in November and December in the south of France and is continuous up to July, later varieties replacing more precocious ones. Forcing under glass is also resorted to, especially for dwarf varieties ; when the young plants have reached a height of 9 to 10 inches the stalks are bent flat to the ground, thus producing more ramification and a greater number of pods. Peas to be gathered ripe are generally sown in March or April and until June.

Of all the shelling peas the *Prince Albert* is the most precocious. The *Emerald* and *Express*, both new varieties, are almost as early, and the *Daniel O'Rourke* is also early, and more productive. The *Caractacus* is less early but more vigorous than the Prince Albert.

The *Michaux de Hollande* is the variety most cultivated in open fields around Paris, a variety of this, the *Michaux de Ruelle,* being much used for preserving.

The *Leopold II* is a rapid grower, giving all its products in a few days, thus being valuable for market gardening. The *Clamart* is a late variety of large grain. The *Shah*, a new English variety, is fully as early as the *Prince Albert.* Other varieties of climbing peas are the *Champion of New England, Duke of Albany, Knight's Wrinkled Sugar-pea,* and the *Telephone* (new), all of which are cultivated in France and were shown at the Exposition.

Among dwarf varieties are the *Gontier*, the best adapted for forcing, and almost as early as the Prince Albert; *MacLean's Blue Peter,* very early and of a green grain when ripe; the *Fillbasket* (new), of green grain; the *American Marvel* (new); *Alliance Climax,* and the *Wilson*; the last having a very large seed. The *Ram's Horn* and *St. Desérât* peas are climbers, having a soft, edible pod, and are hence called "*Mangetout,*" and the *Royal* and *Capucin* are dwarf peas of the same sort. The dwarf *Serpette* of the French is the *William Hurst* pea of England, introduced into France in 1888 and much esteemed.

Another variety of the pea is the Chick-pea or Garavance *pois chiche* (*Cicer arietinum*) quite common in southern Europe and of Italian origin; when cooked whole it is indigestible, but it may be used as a purée. In warm countries it may be sown in the autumn and gathered in the following summer, but in France it is sown in the spring and gathered in the autumn, before it is quite ripe. The pois-chiche is very common in Spain and there are many precocious varieties there, those with white seed being used for food, and those with red and black for animals only. This pea is also used as a succedaneum for coffee in France and is a good green fodder, especially for sheep, and is also a good green fertilizer.

The *Gray pea* (*Pisum arvense*) is also much used as a green or dry fodder, especially for sheep, either alone or in mixtures.

The Lentil (*Ervum lens*) belongs to the south of France, but is cultivated about Paris, succeeding well in dry, sandy soils; in rich lands it gives much stalk and leaves and little grain. There are several varieties, usually sold after being dried and split. The lentil is also used as a forage, but is not so much cultivated at present as formerly. Green vegetables used for cooking were not shown at the Exposition anywhere except upon the Trocadéro, in the tents above referred to, where they made a most beautiful display.

Asparagus is native to many parts of France, and is one of the most popular vegetables. There are two principal varieties, the common and the large violet Holland, the former of which has been greatly improved by experimental culture at Argenteuil, near Paris. No especially new varieties were shown.

ARTICHOKES (*Cynara scolymus, L.*) of large size were also exhibited. Only five varieties are enumerated by French seedsmen, and only one of these, the *Laon*, is extensively cultivated around Paris or in northern France, though a winter variety is grown in Provence.

CABBAGES were shown in great variety. This plant, a native along almost the whole western coast of Europe, has been greatly modified by cultivation, and there are now over 70 varieties of it, which may be divided into 7 classes, all of which were more or less represented at the Exposition. Of these the ordinary cabbage, *chou pommé*, or *cabus*, is the commonest, the most noteworthy varieties of which are the *Étampes very early*, one of the best and adapted either to autumn or spring culture; the large *York*, a good spring variety; the Joanet or *Nantais*, an excellent small and very early cabbage; the large *Cœur-de-Bœuf*, very productive but only moderately early; the *Sugar loaf*, a long, oval cabbage, succeeding well even in warm climates; the *Quintal*, or *Alsace*, a large cabbage and one of the most productive, which is much cultivated in Alsace and Germany for sauerkraut.

All the above have compact heads; the *Milan* cabbage is more open, and there are several varieties, the best of which is the *Milan des Vertus*, very productive and much improved during 50 years of culture about Paris. The *chou à grosses côtes*, or butter cabbage, is a still more open variety, with large leaves. Very early cabbages, such as the *Étampes*, or *York*, are generally planted toward the end of August or first of September; the larger and later varieties are planted in August or in February and March. The *York*, *Cœur-de-Bœuf* and *Sugar loaf* come to a head in May, and there is a regular succession of ripening varieties until December. The Milan cabbages are planted in February and up to May. Cabbages generally require good, loose soils, with plenty of manure, and transplanting should be done with great care.

Brussels sprouts were on exhibition, and also *Cauliflowers*. The former are planted in April and transplanted in June, giving products throughout the winter. Cauliflowers of which the principal varieties are the dwarf *Erfurt*, the *Lenormand*, the *Holland hard* and the *Parisian half-hard*, are planted at various seasons in January or February. They are cultivated under glass and afterwards transplanted into the open air. Cauliflowers require good rich soil, copious manure and frequent watering. Two varieties of cabbage much more common in France than in America are the *Chou-rave* or kohlrabi and *chou-navet*, the former with a fleshy stem resembling a large radish, and the latter with a fleshy root and very much like a turnip. Late varieties of these are sown in May or June to be gathered in three or four months.

A peculiar variety, related to the cabbage is the *chou-marin*, *Crambé*, or sea kale, much cultivated in England, but somewhat neglected in France.

EGG-PLANTS. *Aubergines* (*Solanum esculentum*) were also shown to a small extent, and do not seem to be much appreciated by the French. This is a plant belonging to hot climates and requiring great care in culture at Paris. It is planted under glass in February or March, each plant being transplanted to a second pot, and later transplanted again, generally under shelter of a wall. It ripens in August but may be so forced as to ripen in July. The principal variety is a long violet one, and there are also dwarf varieties; an improved large purple variety from New York is also common.

RHUBARB was also shown, but it seemed rather inferior to what is to be seen in America. Its use is increasing in France as a vegetable for cooking, though the medicinal use of its root has been long known. The principal variety is the *Nepaul*, and is planted from seed or by division of the roots.

The TOMATO is a very favorite vegetable in France, and was shown upon the Trocadéro in a great many varieties. It has been remarked that varieties of the tomato are in a way to become almost as numerous as those of the bean; entire series are produced every year, though less so in France than in Italy or in America. Soon the better sorts only will remain and the poorer will disappear. This would certainly appear to be the case from an inspection of the shows upon the Trocadéro.

Among these many varieties a few may be mentioned as follows: The *Large Red*, vigorous and productive, and the most cultivated of all, especially in Provence where it is grown in the open fields; the *Large Early Red*, more precocious than the former and more suited to the northern parts of France; the *Roi Humbert*, a scarlet egg-shaped fruit. The *Cerise*, numerous specimens of which were shown, is a small red fruit, not larger than a cherry, many of which grow together along a long stalk. The *Poire* is a small pear-shaped tomato which keeps well through the winter.

New varieties, 1888–'89, are the *Perfection*, a medium-sized red fruit, moderately early and very productive. The *Chemin*, an early red variety which bears 12 or 15 fruits or more in a single bunch, and closely resembles the Perfection. *Laxton's Early Open-air* tomato, of English origin, is much cultivated in France, and is an improvement upon the Early Red. In the French climate it resists disease better than other varieties, and is less difficult to raise. Finally, the *Mikado*, an American variety, hardy and productive, though somewhat tardy, was introduced in France in 1889, and is much appreciated.

ROOTS were also shown in variety. Of all the roots cultivated in France by far the most important is the beet (*Beta vulgaris*), as it enters into cultivation in a triple capacity as a garden vegetable, a forage plant, and also as a source of sugar.

Beets cultivated for the market were but sparingly shown upon

the Trocadéro, some of the principal varieties being the *Long red*, *Red dwarf*, *Dell*, and *Covent Garden*, also the *Eclipse* (new), and *Trevise* salad-beet (new). The *Egyptian* is the earliest of market-garden beets, and has a flattened root of a dark red color. When sown in April it may be eaten in June. Beets for the market are sown from the middle of March until May, and prefer deep, sweet soils which have been manured the year previously.

FORAGE BEETS, or mangel-wurzels, some of enormous size, were plentifully shown upon the Quai d'Orsay. The principal varieties cultivated in France are—

The *German*, of long, straight root, two-thirds of which projects above the ground in growing; the *Disette Mammoth*, a very vigorous

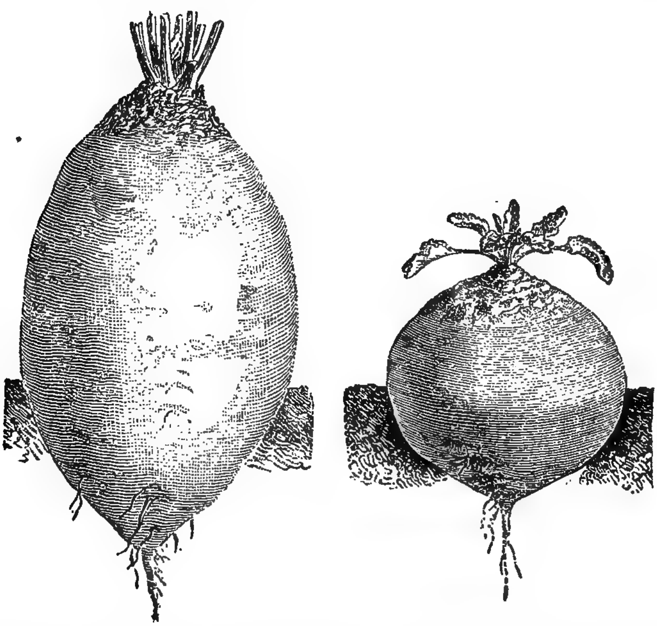


FIG. 13.—Forage beets. *a*, Yellow Ovoid-des-Barres ; *b*, Orange Globe. (From Vilmorin.)

variety, two-thirds to three-fourths projecting, and of a wine-red color; the *Disette Corne-de-Bœuf*, curved, and with a thinner root, a variety of the German, and preferred in many localities in spite of its inconvenient form; the *Red Globe*, almost spherical, which may be gathered earlier than other varieties.

The *Yellow Ovoid des Barres* (Fig. 13) is perhaps the most cultivated of all forage beets, as it unites all the good qualities, being hardy, of vigorous and rapid vegetation, and of superior nutritive quality. Two-thirds of it projects above the ground and is of a bronze-gray, while the one-third below ground is of an orange yellow, the flesh being completely white.

The *Yellow Vauriac Giant,* a new variety in 1888, is an improvement upon the des Barres, being longer and larger.

The *Yellow Globe* is one of the best forage beets, hardy and containing just enough sugar to warrant its use for distillation. There are several varieties of it. Like market beets these forage beets require a healthy soil with previous manuring. Their culture being upon a very large scale, many sowers, beet-pullers, etc., have been invented.

The culture of the SUGAR-BEET commenced in Prussia toward the latter half of the last century, and has attained such development that now Europe produces from the beet more than one-third of all the sugar annually consumed in the whole world. Consequently, being so important a crop, much sugar and many sugar beets were shown at the Exposition, and in no exhibit were they better displayed than in that of France.

Sugar made from them was exhibited at the same time, all stages of the process being illustrated.

In 1887 the sugar beet was cultivated in 34 out of 89 départments of France, principally in those of the north, this culture occupying 194, 425 hectares and the harvest amounting to 51,239,069 quintaux métriques* (over 5,000,000,000 kilos), or about 26,354 kilos per hectare. The average value of 1,000 kilos of beets being 22 francs 80 centimes, the total value of the above harvest would be about 117,000,000 francs. Less than three-quarters of this amount (or more exactly only 3,614,000,000 kilos) were consumed by the sugar refineries.

The surface occupied by beet culture varies yearly; in 1881 it was 210,000 hectares, and since that year it has been affected by the crisis caused by German competition, but stimulated by the law of 1884 it will doubtless soon regain its former extent.

The yield per hectare is also variable, being influenced by the season and mode of culture; official figures show for—

	Kilos.		Kilos.
1881	34,481	1885	28,320
1882	35,013	1886	32,302
1883	36,568	1887	26,354
1884	30,275		

The varities of beet cultivated since the law of 1884 are less productive in weight, but richer in saccharine contents than previously, and as they are now sold according to percentage of sugar contained, the farmer makes a good profit from them. Formerly beets, sold by weight, brought from 18 to 22 francs per tonne, but now they bring 25, 30, or 35 francs per tonne and the yield in sugar is doubled.

It has always been considered that the production of a highly saccharine beet was peculiar to German soil and climate, but since

*A quintal métrique is equal to 100 kilogrammes, or 220.46 pounds.

1884 it has been shown that equally good results may be obtained in France, the production being simply the result of a combination of several factors of special culture, such as the adaptation of the seed to the soil, the nature of that soil itself, the rotation practiced, the fertilizers used, the distances between the plants, etc.

Since the quality of the seed has so great an influence upon the crop a special industry of cultivation for seed alone has sprung up among the northern départments. Beets to be grown for seed are selected with rigorous care, the form of the root and the leaves, the firmness of the flesh, and the contents in sugar being all taken into consideration. For the latter purpose a rapid yet accurate method of analysis has been invented and laboratories have multiplied, many cultivators having their own laboratories at their plantations. Extreme care in cultivation is also observed.

The climate most favorable to the production of the sugar beet is one in which the summers are hot and rainy while the autumns are cold and dry; these conditions obtain in many parts of Central Europe and in several parts of the United States, especially in Nebraska.

The nature of the soil is also important; it should be mellow, porous, and deep, with a permeable subsoil, and should be free from stone and well exposed to sunlight; good wheat soils are the best for the sugar beet.

Much has been said about rotation. In Germany the beet is allowed to succeed wheat upon manured land which has previously lain fallow; this system always gives more sugary beets, ripening at the proper time, and less subject to attack from insects or disease, and is easy to practice with square-head wheats, which require strong manuring and give large yields. In the French rotation the order is reversed, and the beet is cultivated upon manured land and followed by wheat; this system is successful if the manure is dug into the earth before the winter, the best manure being used; otherwise, especially in dry years, the beets do not ripen.

Manure for sugar beets is composed of organic fertilizers (guano, etc.), farm manure, seed-cake, and of artificial fertilizers, such as nitrate of soda, sulphate of ammonia, superphosphate of lime, etc.; chlorides have been found to be prejudicial. In these fertilizers the nitrogen and phospheric acid are the important elements, the former increasing the total yield while the latter increases the amount of sugar through limiting the too great development of the leaf. In Austria the application of liquid fertilizers has been tried with good results.

Sugar beets should be sown rather close together; in good cultivation eight or ten roots are planted in a square meter, and it is found that thus there is as much total weight of root per hectare

and a greater yield in sugar than if the plants were farther apart, since, being so near together, the roots are limited in their development and remain of medium size, *i. e.*, from 500 to 600 grammes each, and being small they ripen at the proper time to insure the purity and richness of their juice. Besides, being nearer together the plants emit abundant foliage, thus developing the sugar under influence of sunlight. Poor varieties of sugar beet yield only 25 per cent of the total weight of the plant as leaves, while rich varieties yield 50 to 60 per cent; an excess of leaf, however, is accompanied by a diminution in amount of sugar. Care in cultivation is also important; with a soil well prepared during the previous autumn and

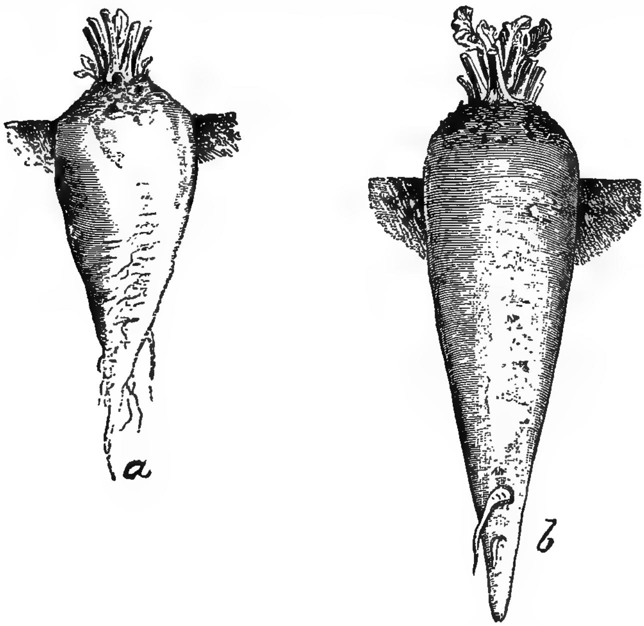


FIG. 14.—*a.* White Silesian sugar beet. *b.* Red-top sugar beet. (From Vilmorin.)

properly managed, the beet will resist unseasonable weather or extremes of drought or rain. Hoeing, either by hand or machine, should be practiced as often and continued as late as possible.

There are several varieties of sugar beet, all derived from the white Silesia (Fig. 14), and which may be divided into two races, the French and the German. Those of the French race generally give a larger yield per hectare in actual weight, but are less rich in sugar than the German.

Vilmorin's improved white sugar beet (Fig. 15), derived from the Silesian and classed under the German race, is claimed to be the richest and most regular variety; it is said to yield 30,000 to 35,000 kilos of roots to the hectare, though with good culture 40,000 might be obtained. It contains about 16 per cent of sugar by weight.

The *Red top* sugar-beet gives the heaviest yield of sugar to the acre.

The principal variety of Germany is the *Kleinwanzleben,* also grown in France. It succeeds well in moderately rich alluvial soils, but in soils rich in humus it does not ripen well and loses in sugar. It easily gives 34,000 to 36,000 kilos per hectare and under exceptional circumstances has been known to give 40,000. It is less rich in sugar than the Vilmorin and its flesh is whiter and more watery. The average sugar contents is 12 to 13 per cent.

Carrots, turnips, radishes, and salsify were among the roots shown upon the Trocadéro. The carrot is much cultivated in France, par-

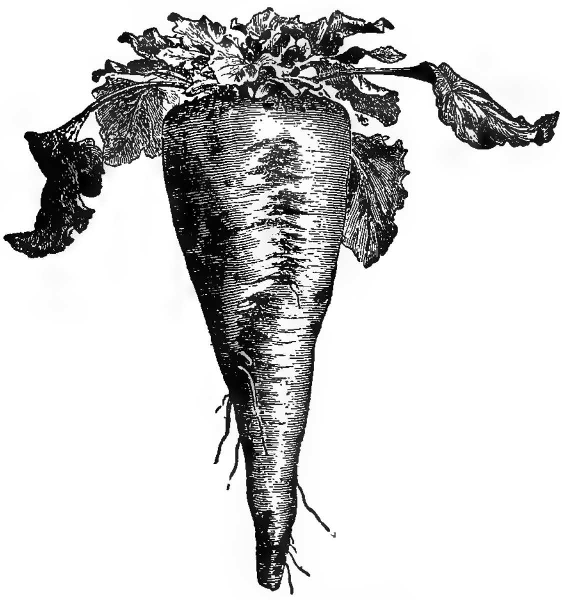


FIG. 15.—Vilmorin's Improved White Sugar Beet.

ticularly the smaller varieties, of which there are many, a new one (1888) being the *Red Parisian forcing* carrot, small, of a flattened spherical form and dark orange color, with few and very fine leaves.

Carrots are sown in all seasons in the open air, except the winter, and even then they are cultivated under glass to supply the markets of Paris. They are also used extensively as a forage plant, and for this use the larger and some of the white varieties are used, being sown from March to June.

TURNIPS of several kinds are cultivated in France, both for food and for forage. One of the best is the *Vertus hammer-shaped* turnip, which has replaced an older variety around Paris. A new red-topped variety of the Vertus has lately made its appearance. The

little flat Milan turnip is the earliest of all varieties. The *Boule d'or* and *Finland yellow* may also be mentioned as good market varieties. The *Norfolk*, the *Navet Turneps*, and *Red Limousin* are more generally used for forage. Turnips are sown from the middle of June to the middle of August, and early varieties as late as September.

RADISHES are particularly good at Paris, and much esteemed, and there are many new varieties. The most cultivated of the smaller sorts is the *Round Rose-color*, which is ready for gathering in from 20 to 25 days after planting, though there are more precocious varieties than this.

Most of these smaller radishes may be planted almost the year round, so that there is a constant supply of them in the market. The longer radishes are planted at Paris towards the end of May, or later than this in the south of France. A variety of radish, large and of a black color, with white flesh, was shown on the Trocadéro.

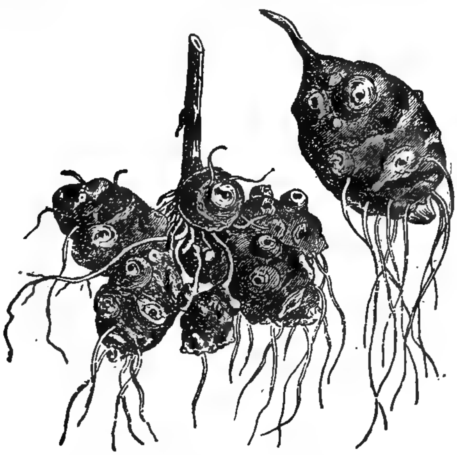


FIG. 16.—Topinambour, *Helianthus tuberosus* (after M. E. Hérisson).

Horse-radish (*raifort*) is also much cultivated, and so is salsify.

An interesting root, much cultivated in France, is the TOPINAMBOUR, or *Earth pear* (*Helianthus tuberosus*), which is called *Jerusalem artichoke* in the United States (Fig. 16). It is of Brazilian origin and is related to the sunflower. It has many advantages: It gives a large crop of roots adapted to the nourishment of nearly all animals, while the leaves also give a good forage; it succeeds well in poor soils, resists drought and the roots, while in the ground, never freeze. It also has its faults, since it spreads too widely in fields where it has been once planted, and is rather harmful to sheep if given in too great quantity. It is planted very much in the same manner as the potato, in autumn or in early spring, 18 to 20 hectoliters being used to the hectare and the planting being done in

lines. Its appropriate fertilizer is chloride of potassium; a table in the collective exhibit of the Société d'Agriculture d'Ille-et-Vilaine shows that without any fertilizer topinambours gave 8,180 kilos per hectare; with superphosphate alone, 6,600 kilos; with chloride of potassium, 23,630 kilos; and with both superphosphate and chloride, 22,800 kilos. Topinambours are also used for distilling.

A new curiosity among the roots shown on the Trocadéro was the *Crosne du Japon* (*Stachys tubifera*). It is a tuber resembling a very small Vitelotte potato (600 weighing a kilogram); the flesh is very tender and aqueous, and the taste rich and somewhat resembling that of the parsnip. The root does not keep well if exposed to the air and should be gathered as wanted, or kept in sand. It is planted in the middle of February until April, preferably in light or sandy soils, and may be gathered toward the end of October or in November.

FIG 17.—Brazilian Sugar Squash. (From Vilmorin.)

PUMPKINS, *Potirons* (*Curcubita maxima*), and SQUASHES, *Citrouilles* (*C. pepo, C. moschata*) were shown in great variety upon the Trocadéro, and some of them were of enormous size. The principal pumpkin grown about Paris is the *Etampes Red*, with a handsome, smooth, orange-colored skin and yellow flesh; it has replaced a large yellow variety, formerly much cultivated. The *Boulogne gray*, a green pumpkin marked by a network of fine gray lines, is a large and good variety, and there is also a small, green Spanish variety. The *Valparaiso*, *Hubbard*, *Ohio* and *Olive*, all more properly pumpkins than squashes, are all grown in France, and were frequently shown as also was the *Turban* squash, or *Giraumon*. A new variety is the *Yokohama*. Among squashes proper (*C. pepo*) the principal varieties shown were the *Marrow*, the *Brazilian Sugar squash* (Fig. 17); the *Crook-neck* (*Courge cou-tors hâtive*) and a new variety, the *Very prolific early*, the earliest of market-garden squashes, of an oval fo m and brick-red color, said

to ripen in three months after planting, each plant giving from eight to ten fruits, averaging 3 or 4 kilos each. A handsome variety is the long white-bush vegetable marrow. Related to the pumpkins, but much smaller, is the *Courge des Missions*, new in 1888, a cream-colored or white variety, flat, divided into sections by eight or ten sutures, and very productive, a single plant giving sometimes a dozen fruits ; in size (6 to 8 inches diameter) and form it recalls our New England summer squash. The *Patisson* or "*Elector's Bonnet*," which is called *Jerusalem Artichoke* in Vilmorin's Bon Jardinier, was also exhibited, but is not much cultivated.*

The musk or *Melon squash* (*C. moschata*) is more usual in the south than in the north of France. There was also a very odd Portuguese variety, salmon colored, very large and entirely covered with large smooth excrescences.

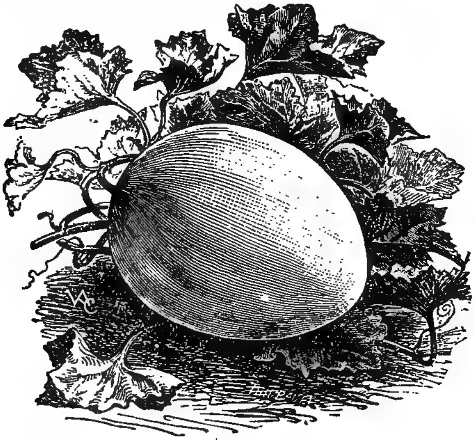


FIG. 18.—Antibes White Melon. (From Vilmorin.)

Another variety shown was the *Malabar Melon* squash (*C. melanosperma*). Heat and moisture are the requirements for pumpkins and squashes ; ordinarily the seeds are germinated in March under glass, transplanting being done in mid-April or May. Open air planting of the seed is also practiced in May. Generally no especial care is taken, but some gardeners cut or bury the principal branches in order to increase the size of the fruit. Almost all squashes are used as forage for cattle in France, preference being given to the larger varieties.

MELONS (*Cucumis melo*) are extensively grown in France, more so than the moderate show of them upon the Trocadéro would

* There is some confusion regarding the name *Artichoke*. The globe artichoke (*Cynara scolymus*) is well known, but in the United States the name Jerusalem artichoke is given to the topinambour (*Helianthus tuberosus*), while in France the same name is applied to the patisson, which is a sort of squash (*Curcubita pepo*) or what we call "summer squash" in New England and "cymling" in the western States.

lead one to suppose. Two principal kinds were shown, the *Melon brodé*, or *Musk melon* with a rough net-like skin which is commonest in France, and the *Cantaloup*, with smoother skin. Of the former kind there is the *American Pineapple Melon*, precocious and giving

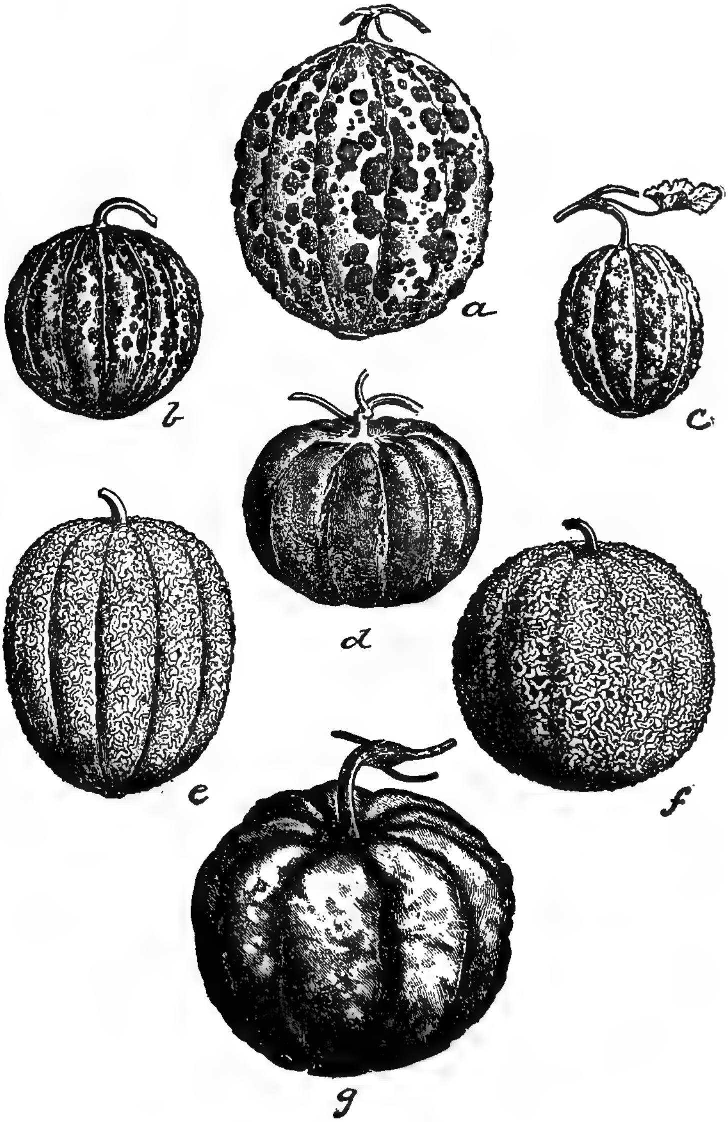


FIG. 19. French Melons: *a* Algerian, *b* Orange Cantaloupe, *c* Prescott, *d* Cannes, *e* Caracillon, *f* Tours, *g* White Cantaloupe (from Delahaye).

6 to 13 fruits per plant, of the size of a large orange. The *Cavaillon* melon, of which there are several different sorts, is much cultivated in the south of France.

The *American Musk Melon*, of oval form and dark green flesh, is also common in France, and the *Malta*, or *Spanish Melon*, is abundant in the south. A new variety (1888) is the *Olive Winter melon*, the best of the winter varieties, and in Provence it is used to succeed the *White Antibes* melon (Fig. 18.) in supplying the market. With a little care it may be made to last until February. The Antibes, a handsome oval fruit perfectly white, is an excellent variety and should be better known than it is; it is a winter melon of good flavor and perfect quality. Among the cantaloupes, the *Bellegarde* is the earliest, the *Noir des Carmes* is the best adapted for forcing, the *Algiers*, an excellent summer melon, hardy and prolific, and the *Prescott*, the most cultivated about Paris. Melons must have very fertile soils and abundant manuring, and in the northern parts of Europe are generally raised under glass; under favorable conditions four or five months are required for reaching maturity. At Paris hot-house forcing is necessary.

WATERMELONS.—*Pastèques* (*Cucurbita citrullus*) do not seem to be particularly in favor among the French. Some were shown on the Trocadéro in August, but were in no way so large or so fine as those to be seen in New England, and those for sale in the Algerian section were even poorer than the French. Two new varieties are cited: The *Seikon*, which is the earliest of all the watermelons and ripens perfectly at Paris, and *Vilmorin's new* melon, with red flesh and red seeds, originating from Provence. Watermelons are planted early, transplanted in rich soils, and allowed to run at will without pruning, being ready for gathering in the hottest days of summer.

CUCUMBERS (*Cucumis sativus*) of good quality were shown; the most noticeable varieties are *White Early*, the *Long English Spiny*, and the large *White Bonneuil*, which last is one of the most productive open-air sorts, and finds an application in pharmacy. The *Concombre à cornichons* is mostly used for pickling, particularly the fine green variety cultivated at Meaux. The *Duke of Bedford* (new) and the *Small Russian Early* are well adapted for forcing. The long *Cardiff* (new) does well in the open air, and a new variety, the *Improved Bourbonne*, is extraordinarily productive and rivals the Meaux variety for preserving. Cucumbers are sown from December to March, and replanted when large enough, or they may be planted without further transplanting in April, May, or June.

GOURDS (*Lagenaria vulgaris. Cucurbita lagenaria*) were presented at every one of the vegetable exhibits, and were of many different colors, shapes, and sizes. The gourd is most often grown only as an ornamental plant, though in some parts of southern France and of Spain it is made into a sort of preserve with other fruits. A peculiar variety is the *Hercules's Club*, a light green club-shaped gourd, some 3 or 4 inches in diameter, and from 3 to 6 feet long or

more. Another curiosity was the Serpent cucumber, dark green, wrinkled, about 2 inches in diameter, and 2 to 4 feet long, and twisted into fantastic shapes.

SALADS are very much more common in France than they are with us, and many different vegetables are utilized in this way. Foremost among these is *Lettuce,* which from its numerous varieties, ripening at different seasons, affords a continuous supply to the markets throughout the year.

Head lettuces, *Laitues pommées,* are the most usually cultivated, and are divided into three sorts, those ripening in the winter, the spring, and the summer; the principal ones are the *Morine,* a very old variety, ripening (or more properly coming to a head and ready for the market) in April. The *Large Blonde Winter* lettuce; the *Mortatella,* of Italian origin; the *Passion White,* a new improved variety, and the *Winter Brown,* a hardy and precocious variety.

The *Tom Thumb,* long known in England, and resembling the French *Gotte,* has only lately been introduced into France, and is found to be very good for forcing. The *Gottes* are spring lettuces, slow-growing varieties, which seem to be much appreciated; the *Crêpes,* with black or white seeds, are very early spring lettuces, with crisp curly leaves; the *Georges* and *Dwarf Green,* also the *Cordon Rouge,* the last with green leaves bordered with red, are good spring varieties. The *Blonde de Versailles, Chio* (new), *Trocadéro* (new), *Palatine Red,* and *Impérial* are good summer and autumn sorts. The *Batavia* and *Grosse Brune Paresseuse* are large, hardy varieties, and are used in fattening swine. The *Batavia Brown* is a variety well adapted to hot climates. *Romanines* or *Cos lettuces* have a long leaf and form an oblong head. The *Romaine Ballon* is of large size and very vigorous. The *Plate Maraîchère hâtive* is a new variety, flattened at the summit and adapted for early planting under glass. The *Alphange* is used as a forage plant. The *Pomme-en-terre* is a good Romaine at almost all season, resisting winter cold. The *Laitues à Couper* do not head, and have curled and fringed leaves more resembling chicory. Winter lettuces are sown from mid-August to mid-September and transplanted in October to southern exposures or at the foot of a wall, being protected from frosts and snow by straw matting. The spring varieties are planted in March and transplanted in April, and are often sown together with other vegetables, as onions or carrots. The summer lettuces, being less early varieties, are sown at the same time with the former, and are also sown successively until July. A custom prevails of tying the heads to make them form (*pommer*) more readily. By a peculiar method, some varieties, as the Crêpe, may be made to give a constant supply throughout the winter. Finally, forcing is much resorted to.

The CHICORY (*Cichorium intybus*) is an interesting plant. The wild plant was first cultivated in 1784, and has since been so improved and modified by culture and selection that it now forms one of the most important of French garden vegetables. The leaves of several kinds are much used as salads, and the stalks, bleached by growing in dark cellars, are also eaten as a salad under the name of *Barbe de Capucin*, which is appreciated on account of its pleasantly bitter taste. An improved variety of wild chicory, called the *Witloof* in Belgium and Endive in Paris, is also much appreciated as a salad. One variety has thick, fleshy roots, which are roasted and ground as a succedaneum to coffee, and this is the principal application of it made by the French, though the custom is said to have originated in Holland.

FIG. 20.—Belgian Witloof. (From Vilmorin.)

The true *Endive* (*C. endivia sylvestris*) is derived from another type of chicory of southern origin, with fine, fringed leaves. The *Scaroles* also have full leaves and somewhat resemble the lettuce. All these varieties, except, of course, the Barbe de Capucin, essentially a winter salad, were shown upon the Trocadéro, while there were several exhibits of chicory root, dried and prepared for coffee, upon the Quai d'Orsay. Endive chicories are sown under glass in January, and their planting is continued under glass or in the open air until July, or when they are for winter use the planting is done in September.

Coffee chicory is very hardy and will grow in any part of France or in almost any soil, but succeeds best in deep, clayey soils, especially those containing some lime. It is most usual, however, in the north of France and in Belgium, the best variety coming from West Flanders. In rotation its proper place is after a cereal (generally after barley) and as it is not gathered until late in the year it may be planted after spring barley. It may be appropriately followed by oats. It has a rather deep-growing root (0.40 meter, or 15 to 16 inches) and should be well manured. Sowing is done during the first half of May, and as nearly as possible while the moon is at its full. Broadcast or machine sowing may be practiced, though the latter is greatly preferred. The roots are gathered in October or November when well developed, and those intended to be grown for seed are preserved in a silo, to be planted in choice soil the following spring.

Previous to pulling up the roots the plants are mown and the leaves and stalks are left as a green fertilizer upon the ground or may be used as fodder, especially for cows, which eagerly eat them.

They are said to increase the supply of milk, though to give a bitter taste to it if their use is continued too long.

CELERY (*Apium graveolens*), though common in France, does not seem to be so universal as it is with us, nor so fine. Wild celery is found in the marshes of central Europe and has been improved by cultivation, and some good specimens were shown. One of the best displayed was an American variety.

The *Céleri-Rave*, or Celeriac, is a variety having a large fleshy root somewhat resembling a turnip. Celery is more frequently cooked in France than in America. To have a constant supply planting is done from January to June,—under glass from January to March, and afterwards in the open air. The plants are bleached by covering them with straw up to the leaves or by heaping earth around them to successive heights.

WATER-CRESSES, *Cresson* (*Sisymbrium nasturtium*), are also much used as salad. They grow wild in many parts of France along small water courses and are simply gathered. Or they may be cultivated by planting in spring time, care being taken to supply them well with water. The *Cresson Alénois*, much used as a salad, is not a true cress, but of Persian origin (*Lepidium sativum* or *Thlaspi sativum*). It does not last long and must be planted often.

The DANDELION, *Dent-de-lion* (*Taraxacum dens-leonis*), is esteemed as a salad. It has been cultivated for about forty years in France. The little town of Montmagny (Seine-et-Oise) sends annually several thousand kilograms of it to the Paris markets. It is generally sown in March or April, and several new varieties are known.

SPINACH, *Épinard* (*Spinacia oleracia*), is extensively cultivated, and used not only as a vegetable *per se*, but also as a source of chlorophyll for use in Appert's process. Spinach may be sown in France from March to October, though the plant suffers considerably by summer heat. There are several varieties, the principal one being of English origin. A new variety, the *Paresseux de Catillon*, with large leaves, is said to resist heat better than the others.

SORREL, *Oseille* (*Rumex acetosa*), is also common as a green vegetable in France. There are several varieties, the best of which is the *Belleville*, grown around Paris. A variety, the *Oseille-Épinard* or *Patience*, is a good garden herb, and is also used in pharmacy, and is cultivated in England and the United States.

Preserved Sorrel, a rarity in America, is common in France, and was exhibited on the Quai. It attacks tin or iron boxes and must be kept in wood.

ONIONS (*Allium cepa*) were constantly on exhibition and many varieties were represented. The *Early White Paris* is the favorite around Paris for eating fresh. The *Blanc Gros* is much cultivated in the south of France, and is very productive and rather tardy.

The *Queen* onion is the earliest of all known varieties. The *Yellow d'Anvers*, *Little Yellow Como*, and *Jaune de Trébons* are good yellow onions and the *Vertus* is much grown around Paris. A fine novelty is the *Ognon Rosé de Bonne Garde*, small, well made, and early, and keeping wonderfully well. The pale red *Pyriform* onion is much used in central France. White onions, especially the early kinds, are used in spring and summer; the others are kept for winter use.

GARLIC, *Ail* (*Allium sativum*), is very common in France, especially in the south. It is sown in February or March from bulbs, since in France, or at least in the north, it rarely comes to seed. The *Poireau* or Leek (*Allium porrum*) is even commoner than garlic around Paris, and several varieties were shown. It is sown in February and March and also in July.

The SHALLOT, *Échalote* (*Allium ascalonicum*), is also much in use. A new variety is the *Jersey*, very different from the ordinary kind and much more precocious.

ANGELICA, a triennial plant of the order of the *Umbelliferæ*, is much grown in France. Its green, hollow stalks, which resemble those of the pumpkin, are much used in confectionery, while the seeds enter into the composition of certain liqueurs. The plant is also eaten as a vegetable in some of the northern parts of Europe, either cooked or as a salad. It requires a strong but not a clayey soil. It is sown in the summer, or sometimes even in March, and must be well watered, and is transplanted in September. The stalks must be cut in the following May or June.

MUSTARD is much grown in France. The black variety is preferred for seasoning, while the white is also much used as a forage plant for cows toward the end of the summer, and being of prompt growth it is generally sown after the regular harvest.

TARRAGON, *Estragon* (*Artemisia dracunculus*), an aromatic plant of Siberian origin, is much used in France as a salad or as a flavoring for mustard. It is propagated from cuttings which are planted in April or May, and when grown from seed has no perfume. The *Tagetes lucida* is often used as an imitation.

PEPPERS, *Pimento* (*Capsicum*), were numerously shown, some American varieties of which are of recent introduction into France.

Of the *Martynia*, or "Martinoe" (*M. proboscidea*), the unripe seed-vessel of which is so commonly used as a pickle in the United States, no specimens were to be seen upon the Trocadéro.

The CAPER only succeeds well in the south of France and is much grown there.

In general the French are fond of seasoning their dishes and use many more plants and herbs for that purpose than we do.

[NOTE.—The figures in this article are mostly taken from the catalogues of MM. Vilmorin-Andrieux et Cie. and are here given not only as illustrations of the vegetables described, but also to show the careful way in which such figures are prepared in France.]

ALGERIA.

That portion of Algeria which lies along the Mediterranean and for a distance of from 50 to 60 kilometers inland is very well adapted for the culture of vegetables of all sorts, as well as for that of the orange and other fruits.

The market gardens of this region are happily situated for the disposal of their products, as these ripen from one to two months earlier than similar products in Europe, and, since Algiers is but 40 hours away from Paris, the country is able to supply all the markets of Northern France with fresh vegetables and fruits from December to May.

The show of these products in the Algerian pavilion on the Esplanade des Invalides was a fair one and included vegetables of many sorts, as peas and beans of several different kinds, potatoes, beets (both for forage and for sugar-making), asparagus, artichokes, egg-plants, sweet potatoes, peppers, onions, garlic, etc., generally of excellent quality. The fruits shown were principally dried figs, besides which there were dried prunes and raisins, almonds, peanuts, and the dried fruit of the carob tree. In the booths about the pavilion fresh specimens of several of the native fruits were constantly for sale, though not strictly exhibited, among which were to be seen watermelons, which certainly looked small and poor when compared with those exhibited by some of the French cultivators upon the Trocadéro.

Beyond the drying of fruits there seems to be no attempt made to preserve vegetables in Algeria, or at least nothing of the sort was exhibited from this country.

Beans (*fèves*) are one of the principal vegetables grown in Algeria, as they are excellent for rotation; they are sown at the same time with the wheat, in December, grow vigorously, and find a ready market.

Haricots (white beans) and *Pois chiches* also grow well there in dry soils, and should be sown in March and April, but their culture is not extensive.

Algeria has, from the time of the Romans, been noted as a wonderfully fertile agricultural country, especially in the production of cereals, and the cereal exhibit was an exceptionally fine one, and some of the best wheat in the whole Exposition was to be found there.

The extraordinarily fertile district in the center of Algeria known as the *Tell* is particularly favored by nature for the production of cereals. It is situated at from 50 to 60 kilometers inland, extending thence for a width of 100 to 150 kilometers south to the foot of the Atlas range of mountains, and is over 1,200 kilometers long from east to west. It contains about 14,000,000 hectares of land, the soil of which is of extreme fertility, its climate is much like that of the south of France, and it could easily nourish ten times the present

population of Algeria, which is about 3,800,000. Before the French conquest (1830) the culture of cereals dominated all other cultures in Algeria and still does so, though viticulture is increasing rapidly at present and promises to soon take the first place.

Hard wheat (*Triticum durum*) was the only kind known to the Arabs, and it is still the most cultivated, though since the French occupation tender wheat is cultivated to some extent. The term hard wheat is somewhat vague and probably means Polish wheat or various sorts of wheat, bearded, with hard polished grain, such as is grown in warm countries like Algeria. There are two principal varieties of hard wheat to be found there; one of these is rather long in the ear and has a light reddish beard and horny, transparent grain, and is mostly grown in the southern part of the Tell; the other is more hardy and less affected by frosts, etc., and has a square head and a long black beard, its grain being duller; it is found in the north of the Tell. No names are given for these. Among the tender wheats (*Triticum sativum*) a fine variety called the *Mahon* is frequently sown of late years. The *Mitadin* wheat also succeeds well, has a thick stalk, and is not, therefore, easily thrown down by storms.

In spite of careless methods much less grain to the hectare is necessary in sowing in Algeria than in France; thus, in October and November barely 80 kilos to the hectare are used; in France broadcast sowing takes from 160 to 240 kilos. Even less than these figures might be needed if mechanical sowers were employed. The general yield is not great, the Arabs get from six to eight quintaux métriques only, while the Europeans, with superior methods of culture, get 9 or 10 quintaux, but not more. Algerian wheat is particularly sought for making *sêmoules* and other alimentary preparations, and is even preferred to Sicilian or Odessa wheat. The average yield from Algerian and Tunisian wheat is, according to official documents, 81 per cent flour and 19 per cent chaff. According to Pliny the elder, African wheat gave 80 per cent flour and 20 per cent chaff, so that there has been but little change since his time. The following comparative table of the weight of a hectoliter of wheat in various countries may be interesting:

	Kilos.
France (*magasins généraux*)	76.160
Crimea	80.000
Sicily	78.750
Sardinia	78.125
Algeria (Alger)	76.125
Algeria (Bône)	78.750

The best Algerian wheat is grown in the arrondissement of Sidi-Bel-Abbès, in the department of Oran.

Barley is produced in large quantities in the Tell, especially by the Arabs, who feed their horses upon it, being of the opinion that the

climate is too hot for giving them oats. They also consume it themselves when wheat is lacking. In newly broken lands it gives a better yield than wheat does, is less affected by drought, and ripens more quickly. Algerian barley is much esteemed abroad for milling purposes, and large quantities of it are sent to England and Belgium. Near Constantine the Arabs cultivate a black barley, which sometimes does better than the ordinary sort. This may possibly be identical with a precocious black barley found in Germany.

Oats are only extensively cultivated among the Europeans in Algeria, who use them freely for their horses. They thrive well and their culture is increasing.

Rye also grows, but it is only cultivated for its straw. The show of *maize* at the Algerian pavilion was a fair one, the principal varieties being the caragua and dent-de-cheval; good yellow, and red maize were also shown. *Maïs rosas* is a small, triangular-grained, white variety. All kinds of maize may be successfully grown in Algeria, but the actual cultivation is relatively small. The Europeans produce more of it than the Arabs, probably on account of their having swine to feed it to. Maize exhausts the soil, which will probably prevent its extensive culture.

Sorghum is shown in both the white and black varieties. The *Bechena* (*Sorghum vulgare*) is only cultivated by the Arabs, especially among the mountains of Kabylie; they eat it and give the straw to their animals.

Attempts at cultivating *Sorghum saccharinum* have not met with success. Another native grain, called by the Arabs *Ilni* (*Panicetum tryphoideum*) is grown by them in the summer.

Colza was cultivated at one time, but in 1867 the crop was destroyed by locusts and its culture has never been resumed. This crop is also seriously affected by the sirocoo.

Lucern gives generally from three to four crops a year in Algeria; with perfect irrigation it has been known to give six or even eight crops in one year. A native variety is cultivated by the Arabs in the oases. The improved cultivation of lucern would be of advantage to the country.

Sainfoin has been tried by some cultivators, but as yet with no success; probably the soil is not calcareous enough for it.

Flax, both of the Riga and Italian varieties, has been tried in Algeria; the former gave good yields, but its culture was abandoned for commercial reasons, and Italian flax was alone cultivated for seed; this, too, failed commercially and, being an exhaustive crop, was never resumed.

Hemp seems only to be cultivated in small quantity around Bône by the natives for producing hasheesh. It grows well.

Ramie has been experimented upon for a long time, but without good results. It also grows well, and with careful culture might

give as many as five crops a year, but its method of working is at fault.

Algerian *cotton* was famous as far back as the eleventh century, and was much sought for by the Venetians in the sixteenth. Its culture was attempted by the French in 1830. During our civil war in 1861 the production of cotton in Algeria suddenly rose from 141,000 kilos to 493,000 kilos in 1864; to 615,000 in 1865; to 744,000 in 1866, and as suddenly fell to 381,000 in 1867, then slowly declining to only 36,000 kilos in 1874, since when there has been no serious cultivation of it. The competition of America and Asia, and perhaps of central Africa later on, will prevent cotton culture on a large scale upon the Mediterranean, notwithstanding the facility with which it grows there.

The soil and climate of Algeria are particularly favorable to the growth of many fruits. The olive is very general throughout the Tell, and its culture there seems to have been of very ancient origin. Figs are grown, especially in Kabylie, and considerable business is done in their exportation; those shown at the Exposition were of fair quality only. The orange, lemon, carob, almond, and pistache all do well in the Tell, and the agave and cactus are acclimated there.

The culture of the principal cereals in 1888 was as follows:

	Hectares.	Quintaux métriques.*
Hard wheat	1,049,108	4,055,837
Tender wheat	189,946	1,424,067
Barley	1,419,554	6,896,146
Oats	51,248	540,126
Beans (fèves)	44,330	272,836
Bechena	35,364	227,314
Maize	12,416	76,526
Rye	437	3,296

* A quintal métrique = 100 kilogrammes.

The following figures of exportation of cereals, etc., are officially given:

	1887.	1888.
Wheat ....quintals..	1,039,155	735,337
Barley .... do...	607,822	501,197
Flour ....do...	33,230	18,090
Green vegetables....kilos..	2,641,640	5,374,725
Dried vegetables......do...	2,863,482	3,827,620
Fresh fruits......... .do...	7,598,012	7,912,379
Dried fruits..........do...	4,282,174	5,035,930
Potatoes ....do...	2,773,403	4,217,012
Linseed ....do...	1,307,573	853,263
Forage...............do...	8,986,178	10,677,639

Cereal culture is diminishing in Algeria from several causes. In the first place, Europeans there are giving more and more attention to viticulture every year, whereas the Arabs, keeping to their old traditions, confine themselves to cereals, principally wheat and

barley, and supply the markets the year around. The grain supplied by them is never of first quality because of their custom of stowing it in silos instead of in granaries. These silos are simply pits or trenches, 1 to 1.50 meters deep, dug in the earth and lined with straw. The grain is placed directly on the straw, covered with more straw, and finally covered with earth, to be taken out as wanted. This treatment is not calculated to improve the quality of the grain.

In the arrondissement of Guelma wheat and barley (for oats are almost unknown there) are sown in October, November, and December upon fields which for the previous two or three years have been left as pastures. After the harvest these fields are again left as pastures for two or three years more, and this style of rotation is continued. Agricultural machines are here only used for the vines. From 2 to 2.20 hectoliters of grain per hectare are used in sowing, and the yield is hardly ever above 10 to 12 hectoliters among the Arabs or 14 to 16 among the Europeans. In the arrondissement of Constantine matters are even worse. No serious rotation of crops is practiced at all, but wheat is sown after wheat and barley after barley, while fertilizers are but very little in use among the Europeans and are entirely unknown to the Arabs. This state of things has been going on for over 20 years.

Other parts of the country are hardly better in agricultural matters. Naturally the result is that the vigor of the soil and the yield of grain are growing less and less each year, and yet cultivators do not seem to think of making any improvement. The great agricultural needs of Algeria are, then, a better plan of rotation, the more general use of fertilizers, and the introduction of good machinery.

The *Oued Rir'* (*subterranean river*, Arabic) is a district of oases in the desert of Sahara, to the south of Constantine. It was first occupied by the French in 1854, and was found by them in a state of decadence, though it had been cultivated since the commencement of the fifteenth century by the Arabs, who had utilized its subterranean waters by means of rude wells. In 1856 the French drove their first iron tube into its soil and established a permanent artesian well, since which time the district has prospered, the land has quintupled in value, and the population has more than doubled.

In 1885 the population was about 13,000 and there were 43 oases containing 114 French and 492 native spouting wells, which gave a total of over 250,000 liters of water per minute, or over 4 cubic meters per second; wells driven 30 years ago have not since ceased to flow and the supply of water is never failing. (Fig. 21.)

The *Société Agricole et Industrielle de Batna et du Sud Algérien* was founded in 1881 for the further development of this district, and at the Exposition made a fine display of its work in the Algerian pavilion, exhibiting in no less than twelve different classes. The principal thing of interest, and the most important in these exhibits, is the show of dates, which was a fine one.

The date is to the Sahara what wheat is to Europe or rice to India, the most important food of the people, and the tree itself is of extreme importance besides its fruit, for every part of it is utilized in some way or other. Even the stones of the fruit have their application, for they are torrefied, ground, and used as a substitute for chicory, and also as medicine. Fine dates, especially of the variety known as the *deglet nour* or "date of light," are exported from Oued Rir', as well as from Algeria and Tunis, principally to Marseilles and thence all over Europe. Their consumption is tending to increase in Europe, and will develop more rapidly as this fruit, now not more than a luxury, becomes better known for its nutritious qualities and divers applications.

FIG. 21.—The Rolland well at Oued Rir', bored in 1882, and yielding 3,800 liters (1,004 gallons) of water per minute. (From a prospectus of the *Société de Batna et du Sud Algérien*).

The *date palm* (*Phœnix dactylifera*) requires a dry atmosphere, but plenty of water at its roots; in a moist atmosphere, for instance on the borders of the Mediterranean in Algeria and Tunis, it does not do so well. It supports perfectly, however, the extreme heat of the Sahara and even the coldest nights there (the thermometer has been known to go down to 6° C. below zero), on account of the dryness of the atmosphere. The nature of the soil in which it grows does not seem to be so important, as even the *deglet nour* is found in the poorest silicious soils. The date palm is planted from shoots and begins to bear fruit in from three to five years, but only bears well after 8 or 10 years, and will continue to bear up to the age of 60. It is best planted at the rate of 200 trees to the hectare, thus giving a good yield and affording proper shelter for other crops.

There are fifty-five varieties of this tree at Oued Rir', the yield of which varies greatly according to conditions of variety, care taken, supply of water, etc.; with good care and proper conditions the trees yield an average of from 4 to 5 francs each, or 1,000 francs per hectare per annum. A single tree is cited as having given 50 francs' worth of fruit in one year. In 1887 the whole district contained 520,000 trees in full bearing, besides 140,000 of from one to seven years old and about 100,000 fruit trees of other sorts. The company above mentioned has planted over 50,000 date palms since its organization. Under the shadow of these palms various crops are grown with perfect success. Barley is the most important cereal, and wheat, maize, millet, and sorghum are also grown.

The company's exhibit shows only the dried vegetables, as pois chiches, fèves, fèverolles, haricots, and lentils, but they also produce potatoes, pumpkins, cabbages, turnips, carrots, radishes, beets, asparagus, artichokes, tomatoes, chickory, celery, parsley, etc.

Among the fruits are melons, watermelons, figs, pomegrantes, apricots, tamarinds, olives, and even grapes.

Lucern is an important crop there, and flax, alfa, tobacco, cotton, madder, and henna are also produced.

A full collection of the products of the date palm was exhibited and fresh *deglet nour* were sent from the colony to the Exposition every week.

TUNIS.

Tunis, a protectorate of France since May, 1881, may be considered as a prolongation of Algeria in all respects, the three principal regions of the latter country, littoral, tell, and highland plains, being continued therein.

The littoral is well adapted for all sorts of fruit-growing, and especially for viticulture and the raising of the orange and olive, and also for the cultivation of all varieties of vegetables, but the inhabitants lack energy of character and industry, and at present these fertile lands are almost wasted.

The central plain, or tell, much intersected by low mountain chains, would be remarkably productive under the care of intelligent colonists with ready means of communication. These plains contain water courses of greater or less importance, none of which, however, are navigable, and few of which are abundant at all seasons. The highlands are, as in Algeria, only adapted for grazing or for growing alfa. Except for the domains of l'Enfida, K'sar Tyr, Bordj-Cédria, and a few others, conducted by Europeans, the agriculture of Tunis is entirely carried on by Arabs, whence its inferiority. Their tools are of the most primitive sort, and they have never attempted to improve them. (Figs. 22, 23, 24.) Pasturing is more common than cultivation; cereals, principally wheat and barley, are cultivated in

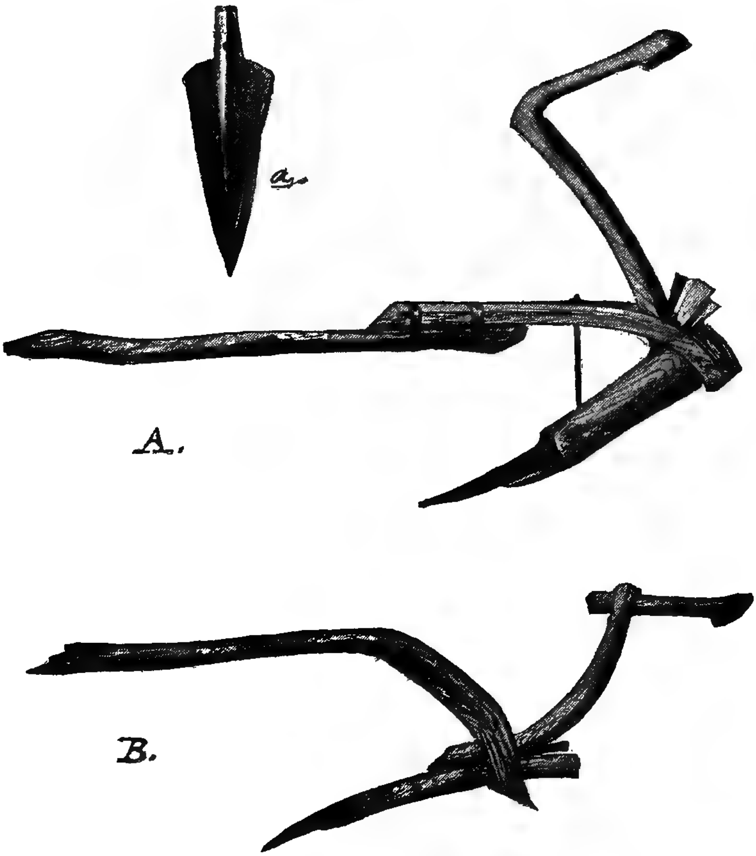


FIG. 22.—Tunisian wooden plows. A, for ordinary cultivation; *a*, Iron share; B, for viticulture.

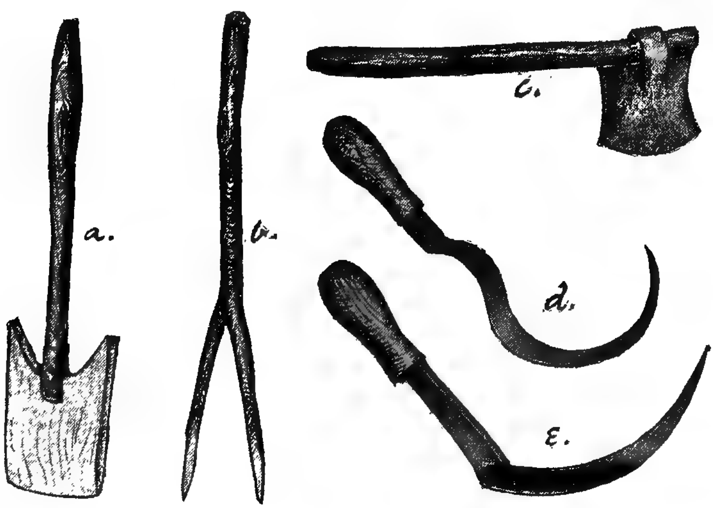


FIG. 23.—Tunisian implements. *a*, Wooden spade; *b*, Fork; *c*, Hatchet; *d e.*, Reaping hooks.

the plains, the Arabs sowing their grain directly upon natural ground which has been used for pasture for three or four years. The quality of grain used is from 230 to 340 liters per hectare, and the yield is only about five times as much as this, *i.e.*, a hectare only produces from 11½ to 12 hectoliters; after the harvest the land is allowed to grow its natural grass for three or four years more, and then the grain is sown as before; this is the native idea of rotation.

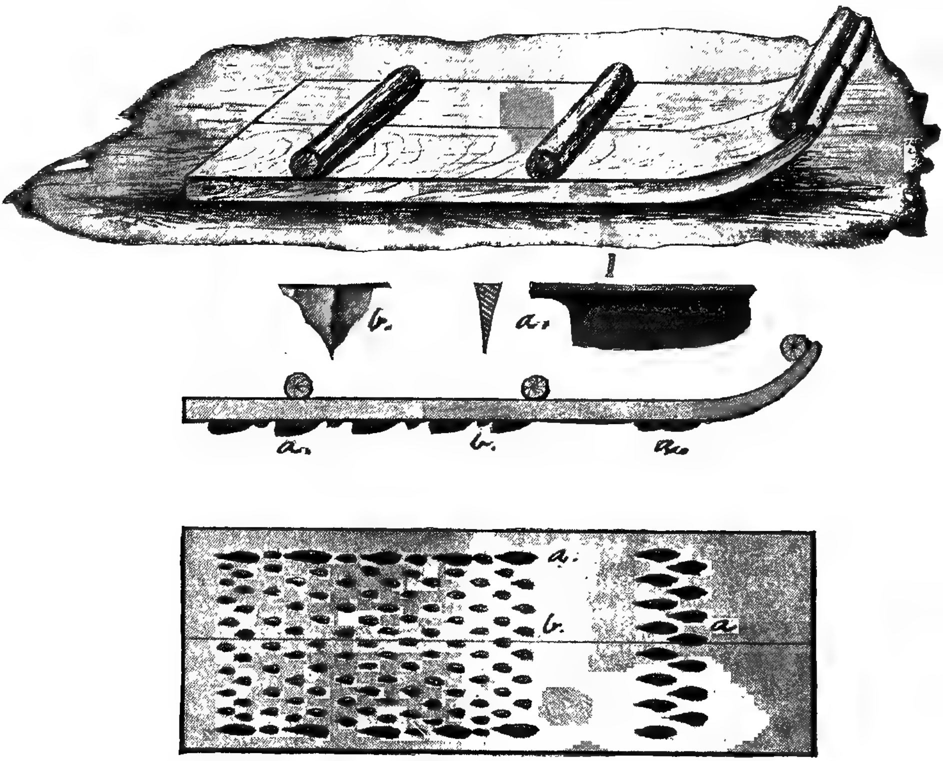


FIG. 24.—Tunisian drag-thresher or *Machine à dépiguer*, consisting of a curved board, the under side of which is studded with iron blades, *a. a.*, and sharp quartz, *b. b.*

In the immense and rich valley of the Medjerda, where the soil, mostly alluvial, is 2 meters (6 feet 6 inches) in depth, double the above yield might be made, without the use of fertilizers, for from fourteen to twenty years. The soil may well be considered virgin and adapted for giving large crops; no great outlay need be made, only the use of European plows. A few such plows, indeed, are seen here and there. Arab plows, instead of destroying noxious weeds, only improve their growth, while they smother the useful plants.

And yet Tunis made by no means a bad show upon the Esplanade des Invalides. It had a fine building to itself and a separate one for its forestry exhibit, which no other country had except France.

Among the Tunisian vegetable products were beans, both white and black, some of the white ones being of large size; fine-looking lentils, pois chiches, and fèves. There was an especially good show of potatoes. The principal thing, however, was the show of dates, the finest in the Exposition after those of l'Oued Rir'. There are many varieties of date in Tunis, but only the *deglet nour* is exported. About 10 varieties are good for food and are bartered with caravans for cereals. The other varieties are of mediocre quality and are consumed by the natives or fed to cattle. The *deglet nour* is only grown at Djerid, where some of the trees are from 15 to 30 meters high, and the yearly production about 31,200 quintals. About 842,500 quintals of ordinary dates are produced annually, and the total date production of the country amounts to about 8,000,000 francs.

In cereals Tunis showed barley and oats of good quality, and some fine wheat, generally hard wheat, as in Algeria.

The maize was yellow and of small round grain, but of fair quality. Sesame and millet were also exhibited, particularly a very large white millet, called white maize by the natives, but not a maize. Almonds and mustard seed were also shown. The almond is cultivated all over the country. The fruit of the carob tree is edible, but is principally used for cattle. The olive is the commonest fruit of Tunis, and the lemon and sweet and bitter oranges are also extensively cultivated.

The *Domaine de l'Enfida* is a tract of land extending for about 30 kilometers along the eastern shore of Tunis and containing about 120,000 hectares. It was purchased by the *Société Agricole et Immobilière Franco-Africaine* in 1881, and in 1884 its population, native and European, was about 12,000. Its climate is healthy, mild in winter, and the sirocco is never so violent there as it is in Algeria. The soil is mostly alluvial, exceptionally fertile, and several meters deep. The natives cultivate wheat, barley, maize, fèves, pois chiches, etc., in a primitive way with primitive instruments, sowing about 60 kilos of wheat or 80 of barley to the hectare; the yield varies greatly, according to frequency of rains, but it is not rare to obtain 25 or 30 for one of wheat, or 50 to 60 for one of barley. The vine is the most promising culture, and is only carried on by Europeans. About 200 hectares were planted with the vine in 1884 and 1885, and almost the whole Enfida is well adapted to its favorable production. The olive is also cultivated there, and apiculture is practiced. The district is comparable to the valley of the Nile. The society has other domains in Tunis, notably at Sidi-Tabet, and made a fine exhibit of its products in the Tunisian pavilion, consisting of excellent wheat, barley of large grain, black-bearded rye, yellow maize, sorghum, fèves, and pois chiches.

Mr. Th. Pilter, an Englishman residing at Paris, made an inter-

esting exhibit of his domain at K'sar Tyr. This domain is situated at about 60 kilometers to the southwest of the city of Tunis, and occupies some 3,500 hectares (8,648 acres) of hillside and rolling plain, at a height of from 80 to 175 meters (260 to 575 feet) above sea level. The soil is remarkable. The higher argillo-calcareous lands are strongly ferruginous and very mellow; the alluvial soil contains much limestone and is easily worked, while in the valleys and lower lands the soil is less permeable, and so is difficult to work, especially after heavy rains. The area actually under tillage is rather less than a seventh of the whole estate, or not quite 500 hectares, and the whole may be divided into three distinct regions, viz: First, the hillsides are devoted to vineyards (96 hectares), nurseries, and various experimental fields; secondly, the plains and valleys are given to cereals and grazing lands; and finally, the greater part of the territory is covered with a growth of mastic, jujube, thuyas, pine, wild olive, and other trees and shrubs now happily protected from the incursions of wandering herds.

The nature of the soil and the position of the vineyards sheltered from the southern winds is particularly favorable, and the vines grow there with unwonted luxuriance, and a very superior wine is produced, which is said to closely resemble the best Bordeaux in quality. The yield in 1888 from 16 hectares only was 182 hectoliters, or about 11½ hectoliters per hectare.

In the nurseries and experiment fields, which are well watered by artificial means, fruit trees of many kinds, such as the apple, apricot, cherry, plum, fig, quince, pomegranate, jujube, almond, and walnut are cultivated and are in thriving condition. Especial attention is given to young olive trees, while many of the wild olive trees have been grafted. There is also a nursery for other varieties, such as the ash, eucalyptus, pine, thuya, cypress, mulberry, poplar, and several varieties of acacia; thyme, lavender, rosemary, etc., are also grown and exported to France.

A fine exhibit was made of the cereals grown upon the 300 hectares devoted to them; Béja, Bladette, Full-measure, and Roumanian wheats were shown, also English and Russian oats, native and Russian barley, yellow maiz, lucern, sainfoin, and Italian ray-grass. All cereals do well there with the exception of oats, which are apt to be small in grain. A field of sugar beets has also given good results.

Agricultural machinery of the most approved type is used upon these plantations, and many of these machines come from Leeds; steam plows were used in the original breaking of the ground.

The *bordj* or farm buildings are furnished with all necessary improvements, including complete apparatus for meteorological observation, the results of which are sent to Paris daily, being the first ever so sent from Tunis.

The domain also possesses some 20 horses and mules and a herd of

63 cows; these cattle are of pure Tunisian and Algerian (Guelma) origin, with a few crosses of Breton stock, though this crossing does not seem to have greatly improved them. There is also a flock of 500 Algerian sheep, improved by crossing with Merino rams. Bees are also raised there with success. The great want of the domain is readier means of communication with the outer world, though these are in preparation.

Another interesting Tunisian farm is that of Bordj-Cédria, owned by M. Paul Potin, of Paris. This is situated upon the bay upon which stand the ruins of Carthage, and is about 26 kilometers from the city of Tunis, and only 3 kilometers from the nearest railway station. It comprises 3,000 hectares, and was bought in 1884 for 135,000 francs. This land stretches along the seacoast for 5 kilometers, and is surrounded upon the east, south, and west by an ampitheatre of mountains, and rises in terraces from the sea to a height of 400 to 500 meters (1,300 to 1,600 feet).

The first 250 or 300 hectares near the shore consist of sand dunes, which have been fixed by plantations of maritime pines and acacias, the last being of the variety *A. cyanophylla*, originating from New Holland. There is upon these dunes an old pomegranate plantation. Asparagus has been tried there, and it is intended to try vines also.

The second zone is a plain of clay and marly soil 3 to 4 meters (9¾ to 13 feet) deep, and formerly marshy, but now drained and well watered. The vine grows well there, and there are 3,000 vigorous olive trees.

The third zone consists of a series of elevations, the highest of which is about 100 meters (328 feet) in altitude, of marl and schist, principally planted with the vine, and including about 600 hectares.

The fourth and last zone is a mountainous limestone region, and includes over 1,000 hectares, which were formerly overgrown with wild thyme, rosemary, etc., and abandoned to flocks of goats belonging to the Arabs. This zone is cut by numerous ravines produced by the waters from higher elevations, and several of these watercourses had been canalized by the Romans. One spring, 208 meters (682 feet) in altitude, has been canalized by M. Potin, and supplies water for the whole domain, and may, perhaps, serve at a later period for motive power. The flow of water is 40 liters per minute. These elevations are well fitted for pine plantations.

The farm buildings, recently completed, contain all necessary conveniences, including wine cellars and presses, agricultural machines, etc. There are also upon the domain some 5 kilometers of paved roads.

The vineyards comprise 406 hectares, all in healthy condition. The soil was formerly overgrown with thyme, jujube, etc., the roots of the latter extending to a depth of six feet, and has all been dug up and cleared by aid of steam plows and a Decauville railway.

Couch-grass (*chien-dent*) is a veritable pest in these vineyards, but is rapidly being eradicated.

The red wine produced is of good quality, as also is the white wine, but the vintage has as yet been made upon 100 hectares only.

Measures are being taken, however, to produce 16,000 hectoliters yearly.

The vine in Tunis is exposed to suffer from great drought, and especially from the sirocco when this lasts for a week or more. Therefore provision has been made for the storing of 700,000 cubic meters of water above the vineyards. These waters are derived from the mountain gorges, and the reservoir for them was made at an expense of 100,000 francs.

There is a large plantation of olive trees. When the domain was purchased these trees, like all others in Tunis, were in a state of complete neglect, but have now become vigorous through pruning and through cultivation of the soil.

About 180 hectares of land near the sea are devoted to cereals and to leguminous forage crops for the cattle. A natural meadow of 50 acres in the plain along the dunes produces excellent hay, and will improve when the works of irrigation are completed. Three hectares of asparagus extend along the shore of the gulf, and are protected from the sands by plantations of tamarind and fig trees.

There are also several nurseries, regarded as among the best in Tunis, which contain, among other trees, the mulberrry, ebony, medlar, fig, American walnut, acacia, araucaria, banana, eucalyptus, and several species of pine. There are many plantations of taller trees used as wind screens, and there is also much restocking of forests, pine, eucalyptus, juniper, carob, and kermes-oak being used for this purpose. These plantations, however, suffer from the attacks of locusts and of rodents, and also from the drought. Upon the dunes bamboo and maritime pine are grown.

There is a garden of 3 hectares defended from the north wind and the sirocco by 25,000 tall eucalyptus trees.

In this garden peach trees succeed admirably, and there are orange and other fruit trees. This farm has 60 horses and mules, and 100 oxen. There is a flock of native ewes with Algerian merino ewes and rams. Two hundred swine are maintained, being sometimes turned into the woods. A Jersey bull has been imported to cross with the Arabian cows, an experiment the result of which will be awaited with interest.

FRENCH COLONIES AND PROTECTORATES.

An especially notable feature of the Exposition of 1889 was the exhibit made by France from her colonies and protectorates in all parts of the world. One-half of the Esplanade des Invalides was allotted to them, and a handsome central palace, besides several other large

buildings, was constructed for their use; these were filled with the products of the several countries, and the industrial and commercial wealth of each was fully set forth in a most interesting series of exhibits, among which agriculture held a conspicuous place.

ÎLE DE LA RÉUNION.

The Île de la Réunion, one of the most flourishing, though not the largest of the French colonies in the Indian Ocean, made a fine exhibit of its products, including sugar, coffee, cocoa, rum, nutmegs, and other spices. The vanilla displayed was some of the best in the whole Exposition. This plant (*Epidendron vanilla*), originally a native of Mexico and Central America, was introduced, about the year 1819, upon several islands of the Indian Ocean, and thrives very well there. It was also introduced into Europe in 1836 as a hothouse plant, but is not much cultivated, though it does passably well. Until 1845 there was little or no exportation of vanilla, but since that year exportation has steadily increased, until in 1872 there were 12,305 kilograms exported, this figure reaching 50,000 kilos in 1885–'86 and 68,856 in 1887.

In 1876 the production of the colony was 28,000 kilos, and since the Exposition of 1878 the consumption of vanilla has so greatly increased that in 1888 there was a total of 150,000 kilos imported into France from Réunion, Mauritius, the Comores, and the Seychelles Islands.

The sugar exhibited by the colony was of excellect quality. About 35,000 hectares are cultivated with the cane, which is probably native to the island. In 1886 the sugar exported amounted to 31,847,149 kilos, valued at 8,559,663 francs, only two-thirds of which amount went to France. The total production has, however, lessened since 1862, on account of the increased price of labor in the island and the low price of beet sugar in France, in addition to which several maladies have attacked the cane.

There was a fine display of European vegetables and fruit, many of which have been introduced into the island. Melons, pumpkins, cucumbers, artichokes, egg-plants, etc., are gathered during the wet season (November to April), while other kitchen-garden plants, as peas, radishes, salads, beets, carrots, tomatoes, onions, and cabbages, are cultivated during the dry season (May to October). Manioc, maize, potatoes, beans, and rice are also cultivated, though potatoes only succeed through abundant manuring. On the higher lands of the islands barley and oats may be grown, but only in small quantity. Fruits, such as mangoes, peaches, pineapples, etc., ripen in the wet season. The orange and lemon trees have been almost totally destroyed during the last three years by a new vegetable parasite. Vine cultivation has been attempted, but without any very marked success.

SENEGAL.

Senegal, on the west coast of Africa, made a display of millet, sesame, rice, arrowroot, maize, white beans, and of native products such as cotton, tobacco, indigo, caoutchouc, palm oil, palm nuts, coffee, ginger, turmeric, and vegetable ivory, also a large exhibit of spices. Kola nuts were also shown, valuable for their caffeine, and but lately introduced into pharmacy. The maize was rather poor in quality, as also was the coffee, The most important articles in the Senegal exhibit were its peanuts and gum arabic.

The Peanut, *Arachide* (*Arachis hypogæa*), is a native of Mexico, but has been introduced into other countries, as India and China, and is especially cultivated in Senegal. In 1802 it was introduced into France in the Département des Landes, but it is a tardy grower in the French climate, and only ripens well in very hot, moist climates, and its cultivation in the Landes also failing financially it was abandoned and never resumed. The best conditions for its growth are fulfilled in Senegal, and it forms the chief article of export. In 1875 the west coast of Africa, from the Senegal River to Sierra Leone, produced annually 100,000,000 kilos of peanuts, the value of which in France was 30,000,000 francs (not shelled). At present (1889), on account of the competition of India for the commoner sorts, the finer only can be grown with profit in Senegal, and the total product has fallen to 60,000 tons, of a value of 16,000,000 to 18,000,000 francs. With better agricultural appliances this yield could be increased, and it is estimated that the Cayor district might be made to yield from 60 to 100 hectoliters, or 2,000 to 3,000 kilos, per hectare. Most of the annual product goes to Bordeaux and Marseilles, where it is pressed for oil, which finds numerous uses. The oil cake is also utilized to a great extent as food for cattle or as a fertilizer.

Gum Arabic, or more properly Gum Senegal, is the most important product of this colony after the peanut, and its exportation amounts to 2,000,000 or 3,000,000 kilos annually, the greater part of which is sent to Bordeaux. Caoutchouc, millet, and rice are also exported, but not to a large extent. A large business is also done in palm oil, coffee, and sesame.

Agriculture in Senegal, entirely in the hands of the natives, has also begun to make progress within the last few years. The colonial government is actively at work for its encouragement, especially since the completion of the railway in 1885.

GABON-CONGO.

Gabon-Congo made but a small show. The principal exhibit was rice, which was very good, besides which there was manioc flour, palm oil, coffee, cacao, tobacco, and maize, the last of very poor

quality. The peanuts shown were not so good as those coming from Senegal. Gum copal, archil, and tinctorial woods are also extensively grown there.

OTHER FRENCH POSSESSIONS IN AFRICA.

Other French possessions in Africa are the Rivières du Sud, a dependence of Senegal, Porto Novo and the establishment of the Gold Coast, and the French Soudan. In the Rivières, rice is the principal product, but it is all used in the country itself and none is exported. Sesame is exported to the extent of about 450,000 kilos annually, being bought there for 200 francs the ton of 1,000 kilos and resold in Europe for from 300 to 315 francs. Peanuts were cultivated there up to 1881, previous to which year their export annually amounted to 7,500,000 kilos, but in that year their cultivation was entirely abandoned; an effort has been made this year to restore this, and a harvest of about 3,000,000 kilos is expected for 1890. The Kola nut is also much grown there, but coffee, caoutchouc, and gum copal, though native to the country, are either badly cared for or allowed to grow wild. Caoutchouc is sent to the coast at the rate of 750,000 kilos a year, and this product might be doubled by careful cultivation. The castor-oil plant and indigo are also indigenous to the soil, but are completely neglected by the natives. In the territory of Porto Novo, which is unhealthy for Europeans but which might be well adapted to agriculture, the cultivation of the oil palm is the principal if not the only one of the country; about 3,500,000 kilos of palm oil and 6,500,000 of palm nuts are exported annually, representing a value of 3,600,000 francs. The Gold Coast Establishments also export about 5,000 tons of palm oil each year. The Soudan exports peanuts, millet, caoutchouc, and other gums.

MADAGASCAR.

Madagascar made but a small agricultural show, and seems to hold textile fibers of rather more importance than other products. Some fine, large-grained rice was shown, and also fine beans, coffee, sugar, vanilla, and cloves, but all these together did not make an extensive exhibit for a country which contains 7,000,000 hectares more territory than France. Agriculture is in an extremely backward condition in the island, which is only just recovering from three years of hostilities. The cultivation of cotton was attempted several years ago by an English company, but without satisfactory results, and was finally abandoned, though it was thought that this culture might succeed upon the western coast. Ramie was introduced in 1882, abandoned during hostilities, and finally revived again, but good decorticating machines are wanting. A peculiar and useful fiber native to the country is laphia, derived from a

species of palm; of late years large quantities of it are used in France, Belgium, and Germany for tying vines and plants. Rice was formerly much more cultivated in Madagascar than it now is and was at one time an important article of export, but the burning of the forests has so modified the climate that its culture has become almost impossible in many places where it once grew abundantly, so that now rice is imported from India. Manioc and arrowroot grow well on the island, the former being much used by the natives. Neither of these articles is as yet exported, though it is to be hoped that they will be, if direct and constant communication be established with Europe. Coffee was first planted in the island in 1872, and in 1875 the annual exportation reached 200,000 kilos, but from several causes its culture failed, though it has since been resumed with better prospects. The coffee is of good quality and several fine samples were exhibited; the price at Tananarivoo is very low, being from 72 to 85 centimes (14 to 17 cents) per kilo. The sugar cane thrives well, but at Tamatave the manufacture of sugar is hampered by economic considerations; some samples of sugar shown in the exhibit were of excellent quality. Caoutchouc is native to the island, and was formerly much cultivated, but the forest fires and bad processes of manipulation have seriously affected this industry. Indigo grows wild, and might be made profitable with good care and cultivation. The island also produces gum copal, wax, vanilla, cloves, etc., considerable commerce being done in these articles.

Dependencies of Madagascar are the islands of Mayotte and the Comores, Nossi Bé, Diego Suarez and Ste. Marie de Madagascar, all in the Mozambique Channel. These colonies show similar cultivation to that of Madagascar itself. The principal culture upon Mayotte is that of sugar cane, which for many years was in the most flourishing condition, but which has of late begun to decline on account of exhaustion of the soil. In 1882 there were 1,780 hectares upon the island planted with the cane, while in 1887 there were 1,714. The colony possesses twelve sugar factories and four distilleries, and the annual production is about 3,000,000 kilos of sugar and 80,000 liters of rum. The coffee plantation occupied 48 hectares in 1877 and only 12 hectares in 1887, this reduction being in consequence of a disease which attacked the coffee plants. The cultivation of fruit trees, cotton, vanilla, maize, manioc, etc., is extending upon this island, and the exportation of vanilla amounts to about 65,000 francs yearly, coming next after sugar (1,140,000 francs) in importance.

The Comores island have an extremely fertile soil with great rainfall, and palms, coffee, sugar cane, cloves and vanilla all flourish there; sorrel is also very abundant.

Nossi Bé, also of exceeding fertility, produces vanilla, indigo, sesame, manioc, cocoanuts, peanuts, sweet potatoes, and various vegetables, in addition to its principal cultures, which are sugar, rice,

and coffee. Sugar cultivation is there mainly carried on by Europeans; and in 1884 there were 900 hectares of cane belonging to thirty-one plantations, thirteen of which were provided with steam engines to work their cane into sugar or to distill rum. In 1883 the production was 906,000 kilos of sugar, 136,059 liters of rum, 931,000 kilos rice, 1,050,000 cocoanuts, and the whole production of the island was valued at 750,000 francs.

At Diego Suarez some of the European colonists have successfully cultivated European market-garden vegetables, and the soil of Ste. Marie is favorable to them. Works of irrigation are in progress at Diego, which when completed will greatly further the cultivation of maize. Caoutchouc is the principal object of exportation.

Obock, an island in the Gulf of Aden, is a new colony since 1883, and is increasing in commercial importance, notwithstanding its extremely hot climate. The principal exportation is of coffee.

FRENCH INDIA.

French India made a full and handsome exhibit, consisting of rice, arrowroot, peanuts, sweet potatoes, etc., but no cereals or vegetables. Rice, as is well known, is the principal food of the native in India, and a fine show was made of it. In the establishment of Pondicherry there were, in 1888, 15,938 hectares cultivated with rice, the harvest amounting to 650,914 kilos. The peanuts were also fine, but not so fine as those from Senegal; of late years the exportation of peanuts has considerably increased, and since 1877 whole steamer-loads have been sent to Europe, the principal exports before that time consisting only of indigo and cocoanut oil. These two last articles of commerce are now much less dealt in, the former having been slowly supplanted by the aniline dyes, while the competition of the English upon the Malabar coast and in Ceylon has been fatal to exportation of the latter from Pondicherry; thus the cultivation of the peanut has replaced other crops in French India, and in six years the export of peanuts increased from 94,700 quintals in 1878 to 525,000 in 1884, representing a value of from 13,000,000 to 14,000,000 francs; most of this, however, is transported by English steamers to Marseilles, Dunkirk, and Antwerp. An agronomic station was established at Pondicherry in 1885.

The Indo-Chinese Union, which comprises French Cochin China, Cambodia, Annam, and Tonkin, was especially well represented at the Exposition, and created a great deal of interest, all of these countries having agricultural exhibits of more or less importance.

Cochin China showed rice, sweet potatoes, cocoanuts, white pepper, tumeric, etc.; also peanuts, maize, turnips, sugar cane, tobacco, coffee, and fruits. Rice is the principal product of the country, but this grain is susceptible of great improvement there; several kinds

of rice are grown, the whole quantity exported in 1888 being 522,500 tons.

Cambodia is a country well adapted to agriculture, but undeveloped. Rice, maize, cotton, indigo, the mulberry, tobacco, and coffee grow well there; also cacao, vanilla, mangoes, oranges, guanas, etc.; maize grows everywhere, and the sugar palm, native to the country, might be made a rich source of revenue; the cardamon is also an important plant there; extensive commerce might also be done in pepper.

Annam is not so agricultural a country as either Cambodia or Tonkin, its resources being much more in the way of mineral products, which, with good means of communication, might be extensively developed. Its territory is for the most part mountainous, while the valleys, though very fertile, are of small extent and do not produce sufficient for the nourishment of the total population. Rice is mostly imported, principally coming from Hongkong and Saïgon. Cinnamon is one of the principal products of Annam, the wild product being more esteemed than that which is cultivated. Cotton grows abundantly and might be made a great source of revenue; the sugar cane also grows well, but its cultivation greatly suffered during the recent war. The tea raised is of inferior quality and is not exported. Attempts at raising coffee have also been made by the missionaries and have met with success, and when developed the cultivation of coffee will be an immense source of riches to the country.

Tonkin is more agricultural than Annam, and produces sugar cane, cotton, indigo, tobacco, tea, peanuts, maize, spices, etc. The great culture is rice, of which a good show was made; the vanilla was also good, but the maize was poor; some wheat, also castor-oil beans, of small size, white pepper, ramie, and betel nut were shown. There was also a collection of agricultural instruments of the country.

NEW CALEDONIA.

New Caledonia and its dependencies made one of the best of colonial exhibits in class 71. Some splendid maize was shown, of long, flat, yellow grain, transparent and fully equal to the best American or Roumanian varieties; some of the ears of maize were of large size. Maize is the principal crop of the island, and replaces the barley and oats of temperate regions; two crops of it may be grown in a year, and the yield is from 2,000 to 3,000 kilos per hectare. It is only used in the colony, however, for animals, both oxen and swine, also for poultry, but the idea of grinding it to a meal for household use seems never to have been entertained. A few colonists make a sort of beer from it, but no samples of this were exhibited. It is to be regretted that the culture and management of maize is not better conducted; there are no storehouses for it, so that when

the harvest is abundant cultivators will sell it at any price to get it off their hands, while after a poor harvest they are obliged to supply their wants by importation from the New Hebrides or even from Australia. The cultivation is also badly done, maize being planted over and over again in the same soil, which is thus exhausted, and the same seed is always used; manure is not of good quality, and rotation is unknown. Much improvement might be made with good methods of agriculture and change of seed; for example, the maize grown in Réunion, which is of the kind called *quatre-mois*, small, but prolific, might be introduced.

Next in importance to maize is the crop of beans, which were shown in many varieties, all of good quality; peas, *pois-chiches*, and lentils were also shown, and all seem to be well acclimated. The beans cultivated and exhibited were principally the ordinary white Soissons, the small white bean, the Algerian black, the ordinary flageolet, the rice bean, and a fine native variety called *Paita*, also the Cape bean, a large white variety, striped rose color. Peas also grow well in the colony, and might be more frequently preserved than they are. The yield of lentils per hectare is not much inferior to that in France, and some fine samples of them were shown.

The third culture in importance is that of coffee, which is tending toward great development, and is in quality not inferior to that of the Île de la Réunion; the samples exhibited were of excellent quality. A peculiar use is made of the coffee plant in New Caledonia, namely, the distilling of a kind of brandy from the pulp of its ripe fruit. Manioc grows excellently in this colony, and fine samples of the tapioca made from it were exhibited. The manioc or cassava is of the "sweet" variety and contains no poisonous principle; there is, however, no commerce carried on with it, as there might be with advantage. A particularly fine exhibit of tobacco was made from New Caledonia; this plant is much cultivated there, and different varieties have been introduced, including those from Virginia and Kentucky.

Sugar cane is cultivated by the natives in a small way, and also on a larger scale for sugar-making by the Europeans, but with indifferent success; more rum than sugar is made from it.

Among the other products of the island may be mentioned rice, cotton, indigo, vanilla, peanuts, cocoanuts, castor-oil beans, and many European vegetables; also lucern, clover, sainfoin, potatoes, etc. Lucern grows well there, and may give three or even four crops a year. Wheat, oats, and Chevalier barley have also been grown with fair success. Wheat was introduced into the colony in 1844, but did not succeed, and its culture was abandoned; tried again with better success, New Caledonia wheat received a prize at the London Exposition of 1858. In 1886 still further experiments were tried with wheat brought from Australia, and so in a measure ac-

climated; these experiments are still going on; the wheat shown at the Exposition was certainly of good quality. Buckwheat succeeds on the island much better than other cereals, and is perfectly acclimated there. Potatoes grow very well, and cabbages attain an enormous size. In 1888 potatoes were imported into the colony at the rate of about 71,000 francs annually, which might be saved were better means of storing to be had.

TAHITI.

Tahiti made a small exhibit only. This island is one of extreme fertility and has many interesting products, and it is to be regretted that its display was not larger. The bread fruit, taro, feï, and cocoanut form the basis of the native food, and were all exhibited. The feï is a sort of banana, not containing sugar. The sugar cane is supposed to be native to the island, and is cultivated there, though not so extensively as it might be, owing to want of labor, so that the supply is not sufficient for the demands of the colony itself. Tahitian cotton is famous, and at London is preferred above all other grades, while the oranges grown there are said to be the finest known, and their exportation is a fruitful source of revenue. Coffee does very well there, and blossoms twice a year, in March and September. Vanilla has been introduced and is thriving, but has not yet achieved the reputation hoped for it. Maize, sweet potatoes, and various other vegetables are also grown. The revenue of the colony derived from its agricultural products and its fisheries reaches an annual value of about 5,000,000 francs.

The most important of the American colonies of France is Guiana, in northeastern South America, yet it did not make a very notable exhibit of its products; some fine clover, also coffee, rice, castor-oil beans, sago, etc., were shown, however. Guiana, formerly a colony where agriculture flourished and which sent many products to France, has lost its former prestige. The reasons given for this are the abolishment of slavery and the discovery of gold. The sugar industry, the principal one of the colony, entirely ceased in 1882.

GUADELOUPE.

Guadeloupe made a small exhibit, principally of rice, which has but lately been introduced from Cuba and is succeeding well. The principal cultivation is sugar cane, after which come coffee, cacao, cotton, manioc, etc.

MARTINIQUE.

Martinique sent fine sugar, coffee, cacao, manioc flour, kola nuts, baobab fruit, and pineapples. Much rum is made in the island, there being a fine display of it. The sugar cane was introduced into

this island in 1654, and now the cultivation of it occupies one-quarter of the whole territory, abundant rains and a soil rich in nitrogen and silica making this cultivation unusually prosperous. In 1867 there were 18,565 hectares thus occupied, in 1877 there were 19,263, and in 1886 there were 28,450. In 1887, however, a crisis occurred and the latter figure fell to 21,300 hectares. The cane in Martinique happily escaped the disease which attacked it at Réunion. This crop is still susceptible of great improvement. Vegetable cultivation at Martinique is in prosperous condition and at the end of 1887 occupied 17,146 hectares, mostly carried on by small farmers. Manioc is the principal product, also sweet potatoes and yams, and many European vegetables. Coffee was at one time the principal product of Martinique, and in 1788 its exportation was valued at over 8,000,000 francs, while its cultivation extended over 6,000 hectares. In 1830, however, the plant was attacked by an insect (*Elachista coffeola*), so that its cultivation almost entirely disappeared and does not now occupy 200 hectares. A new variety of coffee has, however, been lately introduced from Liberia, and is said to resist the attacks of the insects, so that its culture is developing. The introduction of a Mexican coffee plant, also resistant, has been suggested. The culture of tobacco and of cotton, once extensive, have also been gradually abandoned in Martinique.

ST. PIERRE AND MIQUELON.

St. Pierre and Miquelon, two islands off the coast of Newfoundland, which complete the list of French colonies in America, are not especially agricultural lands, and made no exhibit beyond the products of their fisheries.

AUSTRIA AND HUNGARY.

The only exhibit of note from these countries was one of sugar-beet seed from Prague. This industry has received considerable development in Bohemia since 1885, the number of cultivators having increased, and the quality of the seed having been so improved that it is now claimed to be superior to either the French or German seed.

There was also an exhibit of good ordinary dried prunes of the crops of 1885 to 1888, but beyond a few good samples of barley and a collection of scythes there was nothing else of agricultural interest, which is rather surprising, as Austria is an extremely agricultural country and Hungarian wheat is world famous. The soil of Hungary is particularly adapted to the cultivation of cereals. The wheat grown there is rich in gluten and is greatly in demand among foreign millers, notwithstanding high duties upon it. Wheat is also the crop which in Hungary gives the surest yield, since barley and oats do not so well stand the dry climate.

Barley is increasing in cultivation since improved varieties have

been used, and will increase further as the demand made for it by brewers increases. Oats have also increased with the increase of horse-raising.

The cultivation of maize in Hungary has been greatly facilitated by the use of horse hoes. Its consumption has lately decreased, however, on account of a crisis in distillation, and the increased tax on alcohol.

About half the arable land of the country is adapted to the sugar beet, this culture being greatly aided by the use of steam plows. A law passed in 1888 levying a duty upon the sugar beet has greatly favored its culture and has rendered Hungary independent of Austria and Bohemia in this matter. In 1888–'89 four great sugar factories were constructed, and the Hungarian Government is doing all it can to encourage this industry. The cultivation of clover has increased of late, and the seed is sent all over Europe. Lucern has also increased. Moha has also had slight extension, and grows well in the dry climate. Potato culture has greatly developed, thanks to the introduction of new improved varieties, while the dry climate is unfavorable to the development of potato diseases.

BELGIUM.

This country had a rather small but good show of preserved vegetables and fruits in boxes. The *Aspergeries de Bockryck* showed good preserved asparagus and green peas. M. Bertram, of Brussels, showed cauliflower in barrels, and preserves annually about 1,000,000 kilos of it. There were several other fine shows of asparagus, green peas, mushrooms, and prepared soups in glass and tin.

Belgium first took part in the industry of preserving vegetables, etc., only in 1880. In that year the country had 39,723 hectares under cultivation as kitchen and market gardens, and yet was dependent upon other countries for her vegetable supply, although her whole agricultural domain was increasing in extent. In 1846 there were 1,777,920 hectares under cultivation, in 1866 there were 1,955,146, and in 1880 there were 2,704,957.

Since 1880 many factories for preserving vegetables have sprung up in Belgium, and their number is still increasing, but although they are in a flourishing condition they can not yet rival those of Paris.

Belgium also showed a few cereals. The cultivation of these occupies about one-third of her territory, and the annual production of wheat is estimated at about 432,000 tonnes, or 432,000,000 kilogrammes annually. As 1,065,000 are annually required for home consumption, the remaining 633,000 tonnes have to be imported and come from Russia, Roumania, the United States, and India. Cereal culture has not increased greatly since 1856, the number of hectares

cultivated in that year being 267,363, while in 1880 it was 275,932, or an increase of only 8,569 hectares in 24 years, or about 3½ per cent. The average yield of wheat per hectare in 1880 was 19.60 hectoliters; in 1888 the harvest was poor. The cultivation of rye has lost much of its former importance; in 1880 there were 277,639 hectares sown with rye, and in 1856 there were 292,102 hectares, *i. e.*, the decrease in 24 years has been 5 per cent. Oats on the contrary have increased 13 per cent in culture in the same period. Cereals entering Belgium are free of duty, and the milling of wheat for flour occupies the first place in Belgian industry.

The cultivation of the sugar beet and manufacture of sugar are also extensive in this country. This industry began to be general in 1836, and in 1884 there were 45,000 hectares planted with the sugar beet, which figure, however, fell to 40,000 in 1888.

The cultivation of chicory in Belgium originated with the continental blockade of 1806, and within the last few years it has attained much development. In 1846 there were in the country 1,828 hectares cultivated with chicory; this figure increased to 4,719 in 1866 and to 11,025 in 1884. The average yield was 20,573 kilos per hectare, the price being 21 francs per 1,000 kilos. In 1885 the chicory crop was unsatisfactory on account of the drought, and in 1887 there was a ruinous fall in prices. Belgian chicory is exported to all foreign markets, but is unfortunately subject to rather high duties. In 1887 the total exports were over 42,000,000 kilos, valued at about 9,250,000 francs; of this amount 654,541 kilos went to the United States, while France was the greatest consumer, taking over 18,000,000 kilos.

DENMARK.

Denmark made no exhibit of agricultural products and yet agriculture is the principal industry of the country; 51 per cent of the population are engaged in it, while wheat fields, pastures, and meadows occupy nearly 75 per cent of its territory. The character of Danish agricultural products has changed considerably of late years; formerly cereals were of the greatest importance, but now the raising of cattle and of animal products has replaced them. In 1876–'80 the exportation of cereals amounted annually to an average of 39,000,000 francs in value; this has ceased to exist and in 1887 cereals were imported to the value of 16,500,000 francs. At the same time the exportation of horses and cattle, live and dead hogs, butter, etc., has considerably increased; thus, from 1866 to 1870 the average annual exportation of these articles was 37,500,000 francs in value, and is now nearly four times that sum, being 132,000,000 in 1887; the most important items are the butter and lard, none of which, however, was shown at the Exposition.

A large proportion of the cereals grown in Denmark is used for brewing and for distillation, and one brewing firm had a fine exhibit of native-grown chevalier barley, used in making its malts; this barley compared favorably with any in the Exposition.

Since 1874 the manufacture of beet sugar has sprung up in Denmark, the total production in 1887 being 21,000,000 kilos.

GREAT BRITAIN AND COLONIES.

The only notable exhibit made by England in class 71 was that of Favre & Co., Singapore merchants, who showed preserved Asiatic fruits, such as pineapples, mangoes, mangostinoes, goyave, carambola, breadfruit, "jackfruit," ginger, etc., all preserved in sirup or in their own juices. Bastiani, also of Singapore, had a similar exhibit, his pineapples being preserved by a secret process. Joly had a good show of vanilla, and Rouhier a fine one of preserves, curry-powder, and the like. King & Co. showed desiccated foods, soups, etc., of mixed animal and vegetable products, also preserved potatoes. No tubers, farinaceous vegetables, roots, etc., were shown.

With the exception of two exhibits of hybrid wheats, England made no display of agricultural products, properly so called. Her display of agricultural machinery, however, was fine.

The exhibition of "Carter's Crossed Wheats" was an interesting one. Experiments were commenced in 1883 with the view of obtaining varieties of wheat suitable to the climate of Scotland, where very often the varieties now in use do not ripen before October or November, and are thus lost. It was also decided to cross white and red wheats, so as to obtain the color of the one with the vigor of the other. Some very good results were shown, being crosses derived from fillmeasure, red square-head, royal prize red, Talavera and other well-known varieties. In general it was found that length of straw was influenced by the male parent, while form and size of grain were derived from the female. A curious result was named "birdproof" wheat, from the fact that the ears are provided with sharp awns at the end, which cause birds to approach them with caution; this variety was derived from the *fillmeasure* (female parent) and an American bearded wheat (male).

VICTORIA.

Among the British colonies the finest general show was made by Victoria, and next after that by New Zealand, each of these making a better agricultural exhibit (except for machines) than England herself. Victoria was the only one of the Australian colonies extensively represented and had an exhibit of evaporated fruits and vegetables, tomato sauce, jams, etc., and a fine, though not very ex-

tensive exhibit of grain. Some of the varieties shown were as follows:

Wheat:
- Rattling Tom.
- White Tuscan.
- Farmer's Friend.
- Red Purple Straw.
- Red Tuscan.
- Chaplin Hybrid.
- Frampton.
- Red Mexican.

Oats:
- Potato.
- Black.
- Champion.
- Tartarian.
- Short Sandy.

Barley:
- Chevalier.
- Cape.
- Oregon.

The red Tuscan wheat is a new variety, yielding 42 bushels per acre. Maize was also shown, and was of good quality, being generally of round, yellow grain. A good deal of maize is grown in Victoria, but New South Wales has a better climate for it; Queensland also produces it in large quantities. Maize is not of recent introduction into Australia. Dried peas were also shown, the Yorkshire hero being a favorite sort.

A peculiar method of harvesting grain is practised in Australia, by the use of the stripper, which is really an American invention, by which the ears of the wheat are plucked while the grain is left standing. This machine was not to be found at the Exposition.

Agriculture in Victoria had made but slow progress up to 1869, in which year an act encouraging agricultural settlement was passed which so increased cultivation that three years later, in 1872, there were nearly a million acres under tillage; in 1882 there were almost two and a quarter million acres, of which the wheat alone covered a million. The soil of Victoria is exceptionally fertile in certain localities, a yield of from 12 to 15 tons of potatoes being sometimes obtained. Where small crops are obtained the fault is not in the soil but in the want of moisture, as in moist seasons the yield is large. Throughout the coast districts the rainfall is sufficient for cereals and for some root crops. In the drier districts wheat yields from 10 to 12 bushels per acre, and in districts favorable for high cultivation it may yield as much as 35 to 45 bushels, while hay yields from 2 to 4 tons, and maize as much as 100 bushels per acre. The annual wheat crop is over 15,000,000 bushels in Victoria, and that of oats is nearly 4,000,000; next to these come barley, maize, peas, potatoes, tobacco, etc. The dairy products are valued at nearly £3,000,000 annually; 20,000 acres are cultivated as orchards and gardens, and over 7,000 as vineyards; all the usual European fruits grow there in abundance, also fruits common to southern Europe, as oranges, lemons, olives, etc., and there is a large industry in their canning and preservation. The value of the exports of fruit, preserved or fresh, in 1884 was nearly £50,000. In some districts there

are orchards of from 100 to 150 acres each, and some of the gardens near Melbourne cover 8 to 20 acres. Vegetables of all kinds are successfully cultivated, and some 2,000 tons are yearly exported from Victoria to the neighboring colonies; onions and potatoes are especially abundant, as also are tomatoes. Two crops a year are generally grown.

SOUTH AUSTRALIA.

Agriculture in South Australia seems to be extremely easy to practice, and comparatively large farms are common; an average farm is of 640 acres, and there are many of over 1,000 acres. Unfortunately extreme drought is common. Harvesting commences in the middle of December (midsummer) the wheat ripening very rapidly in the hot, dry weather, and thus requiring the use of the stripper. By the use of machines 100 acres a day may be sown, at a cost of about 3 pence per acre. Reaping costs 3 to 5 shillings per acre, and winnowing 2 to 2½ pence per bushel. The soil and climate of South Australia are admirably adapted to the cultivation of fruits and vegetables, both of temperate or tropical climates; peaches, oranges, figs, olives, grapes, guavas, etc., are grown there, and there are some sixty varieties of apples. In 1883 there were 5,172 acres cultivated as gardens, and 6,566 as orchards. Almond trees are extensively grown and there are about 100,000 trees yielding good crops. Vegetables of all sorts do well there; in 1883 there were 6,063 acres of potatoes, giving a large crop. In the plains of South Australia drought is very frequent, but in the higher lands there is a more abundant rainfall. Viticulture is extensively developed in this colony, and the cultivation of the olive is eminently successful; it is estimated that from 4,000 to 5,000 gallons of olive oil are annually produced in South Australia.

The following is quoted from a book upon "The Australian Irrigation Colonies," distributed at the Exposition:

An authority on olives says: Cuttings taken from bearing trees and planted where they are to remain, will pay expenses of cultivation the third year. Ten acres will support a family the fourth year, and ever afterwards be a source of rich revenue. Olive trees in San Diego County, California, have produced, at a crop, from £20 to £30 per acre. The olive has become an article of universal consumption. Its oil is indispensable in medicine and surgery, and is largely used in the manufacture of fine woolen goods. There is no limit to the demand for it. Olive culture requires a warm, dry land, and it will not flourish in moist soil. (Olive culture, therefore, offers conditions peculiarly adapted to the irrigation settlements upon the Murray River, Australia.) Trees are now growing in San Diego County that, 8 years old, produced 2,000 gallons of olives to the acre. The European standard is 8 gallons of olives to 1 gallon of oil, which gives a profit of 250 gallons of oil per acre. The oil sells readily at £1 per gallon, which gives an income of £250 per acre for the best 8-year-old trees. The net income for such a crop would not be less than £200 per acre, and, with good care, the crop is large and sure for a century. In Italy, Spain, and the south of France, there are 8,000,000 acres de-

voted to olive-growing, and about 160,000 000 gallons of oil are produced annually. That made in France amounts to 20,000,000 annually. The extensive adulteration of olive oil in Europe, however, with cotton-seed oil, has greatly depreciated the public estimate of this product, and there is room for an extensive importation of the pure article from Australia, at good paying prices. In California, the average number of olive trees per acre is about 100, about 1,000 acres being now devoted to this crop. The fruit is usually gathered from November to January, or later. When picked, the olives are divided into grades and will average about 3 shillings per gallon in value, and are generally put up in barrels. The best are worth about 5 shillings per gallon. If made into oil, the olives are crushed thoroughly and pressed. Water is then added, when they are again pressed, and a second quality made. They are pressed a third time, for a third quality, and a fourth quality is also made. The receipts from a California olive grove have several times reached as high as £400 per acre.

NEW ZEALAND.

The only exhibit catalogued under Class 71 was a show case containing ninety-three varieties of seeds. There was also an exhibit of dried apples, dried pumpkins, etc., of fair quality.

New Zealand made a fine show of cereals. The Government sent a trophy of grain, and there were two association and several private exhibits. The principal varieties shown were:

Wheat:
- White Tuscan,
- Red Tuscan,
- Hunter's White,
- White Velvet,
- Mold's "Ennobled,"
- Pearl,
- Purple Straw,
- Red Chaff.

Chevalier Barley:
Golden Vetches.

Oats:
- Poland,
- Tartarian,
- Danish,
- Canadian.

Grasses:
- Prairie,
- Perennial,
- Cocksfoot.

Yorkshire Hero Peas.

Some of the yields stated are spring wheat, 55 bushels per acre; barley, 60 bushels, and oats, 55 bushels. The show of grasses was a fine one.

New Zealand is a grazing rather than an agricultural country, and much grass is sown, especially in the North Island, the bush being burned down and the grass seed sown without previous plowing. In February, 1887, there were in the two islands, 6,845,177 acres, either under cultivation or ready to be cultivated, and in February, 1888, this figure had increased to 7,284,752 acres; of this amount nearly 6,000,000 acres are sown with grasses. In the South Island the ground must be plowed before sowing. There is good agricultural land in both islands, but mostly in the South Island, nearly fourteen times as much grain being sown there as in the North. In 1887 the total number of bushels of wheat raised in the whole country was 6,297,638, the average yield per acre being 24.89

bushels; in 1888 the total production was 9,424,059 bushels, with an average of 26.37 bushels per acre. In 1887 the above wheat was raised upon 253,025 acres of land, and in the same year there were 387,228 acres sown with oats, yielding 11,973,295 bushels, or 30.92 bushels per acre. There were also 27,683 acres which produced 134,965 tons of potatoes, or 4.88 tons per acre.

CAPE OF GOOD HOPE.

The Cape of Good Hope made a small but fair show, containing nothing of agricultural interest beyond its wines.

TASMANIA.

Tasmania was well represented by its minerals, but by nothing else, and no other colonies were represented in the agricultural classes.

GREECE.

This country made a very large exhibit in Class 71, the principal object exposed being dried currants, of which there were forty-four exhibitors out of one hundred and fifteen in the class. Next in importance came farinaceous vegetables, as fèves, beans, peas, *pois chiches*, lentils, and then figs, almonds, olives, walnuts, etc. There was also a show of oil-seeds, as linseed, colza, anise, etc., and of cloverseed, sesame, etc., also some wheat and barley of exceedingly large grain. Some of the walnuts also were very large. A little ordinary maize was shown. The tobacco exhibit was a good one, some of the leaf tobacco being among the best in the Exposition. Much Greek tobacco finds its way into European markets as "Turkish."

Olives were shown, both dried and preserved.

The present King of Greece is said to have remarked that "half his revenue was derived from the plum puddings of England," meaning thereby to show the extent of the dried currant interest in his state, and indeed it is one of the most important interests of the country, and not only that, but one in which Greece has almost a monopoly. In 1888 the harvest of these currants was 160,000 tons, of which 21,000 were raised in the Ionian Islands. Unfortunately the demand is not so great as the supply, and the prices obtained for this crop but barely covered the cost of production. England is the greatest consumer of these currants, and takes only the finer varieties. Of the 160,000 tons raised in 1888 England took 63,000 tons, or nearly one-third—France taking 37,000, and Germany, with Holland, Belgium, etc., 26,000 tons, and the United States, with Canada, only 15,000. It is said that the best qualities are not offered to the American market, and that if they were the American consumption would increase. The poorest sorts go to France, where

they are made into "wine," this branch of adulteration having commenced in 1878, and having increased so largely that France became, in 1887, the greatest importer of these currants, taking 53,000 tons against 46,000 taken by England.

Greece is said to be the only country in the world where the currant vine, or that particular variety of it which produces the fruit in question, will thrive, and all attempts to transplant it are said to have failed.

HOLLAND.

There was in the Dutch section but one exhibit of canned vegetables, which, however, was of good ordinary quality. The agricultural display of Holland was small, but there were two exhibits of interest which deserve especial mention. The first of these was that of the Groningen Agricultural Society, which showed jars of grain and farinaceous vegetables each marked with data, and all representing averages of good harvests, as follows:

[Yield in hectoliters per hectare.]

Summer wheat, in clayey soil	40	to 45
Red square-head wheat	42	55
White wheat	44	46
Prolific white wheat, from English seed	46	50
Early winter barley (Escourgeon)	60	70
Black oats in a clayey soil containing 35 per cent of sand	70	80
Black "President" oats in a mixed sandy and peat soil from which the peat had been removed	80	90
Large white oats	70	80
Blue-podded peas	40	45
Green peas	42	46
Horse beans	35	40
Horse beans in clayey soil containing 35 per cent of sand	30	40

Flaxseed in a soil containing about 40 per cent clay and 60 per cent sand yielded 4,500 to 5,000 kilos of flax and 14 to 15 hectoliters of seed to the hectare.

The second exhibit was that of *Breebaart*, who showed grain, peas, beans, etc., grown in the *Anna Paulorna* and *Waard en Groet* polders.

Polder is a term applied to a morass or a lake the bed of which has been reclaimed by drainage. A great part of Holland and Flanders (Belgium) has been thus reclaimed and rendered extremely valuable for agricultural purposes. The marsh is inclosed by a dike, and the water pumped out by water wheels of peculiar construction, formerly driven by windmills but now by steam engines. When the marsh is deep, a system of dikes, one within the other, and upon different levels, is employed.

The extraordinary fertility of the land thus reclaimed is chiefly accounted for by the fact that superfluous water can be easily and

quickly removed, while in dry seasons a thorough system of irrigation is available.

These polders are drained by speculators, who lease them, in lots, to cultivators. The polders often lie under water in winter, but, provided that the water is not salt, their fertility is not thus impaired.

The principal polders are the *Beemster,* reclaimed in 1608–'12, the land of which is valued at an average of 1,200 florins ($476) per acre; the *Purmer* and *Schermer* and the newly-drained (1876) polder of the river Y. The largest of all is the *Haarlemmer Polder.* This was drained in 1840–1853, at a cost of 13,500,000 florins ($5,355,000), and has an area of about 72 square miles and a population of 10,000, the value of the land being estimated at 800 florins ($318) per acre. The polders cultiveted by Breebart are smaller, but very fertile, and the exhibit of crops grown there consisted of—

Wheat:
- Prolific.
- Victoria.
- Zealand white.

Oats:
- Peerless.
- Scotch.
- Frisian.
- American.
- Probstei.
- Groningen.

Barley:
- Chevalier.
- Spanish.

Beans:
- Horse.
- White (haricots).
- Various sorts.
- Gray and green peas.
- Canary seed, carvi, etc.,

all of which were of excellent quality. A similar but less extensive exhibit was made from the Haarlemmer Polder.

It is proposed to convert the whole of Zuider Zee into a polder, whereby Holland would gain an additional province of 687 square miles at an estimated cost of 120,000,000 florins ($47,600,000).

Another agricultural exhibit showed red and white mustard seed, linseed, hempseed, coriander, timothy, millet, alsike, white clover, besides Chevalier barley, rye, wheat, and buckwheat.

The Dutch colonies had fine exhibits of tropical products, such as coffee of splendid quality from Java, cacao from Java and Surinam, a particularly fine show of tea, large-grained rice, indigo, tobacco, sugar, peanuts, spices, etc.

Luxemburg, made a single fine exhibit of chicory in all stages of preparation, but of no other agricultural products.

ITALY.

In Class 71 this country had seven exhibits in all, none of which were of extraordinary interest. The best of these was that of the *Società Tartufaria Spoletina,* consisting mainly of truffles, besides which were dried prunes, preserved peas, beans, peaches, pears, etc., in glass. Spoleto and its environs are the principal places in Italy where truffles are found; the samples exhibited were by no means to be compared with the fine specimens shown in the French exhibit.

The other articles shown by this society were of fair quality. There was a small show of dried figs especially intended for exportation and not of very striking merit. Large quantities of Italian figs are sent to the United States. Less business is done in chestnuts than in figs, and there was one very poor exhibit of them; these chestnuts are larger than those seen in America but smaller than the French. The other Italian exhibits in this class were not remarkable, principally consisting of dried fruits and farinaceous vegetables and a little poor maize. There was also a very poor collection of wax models of fruit; the real fruits would have been a better exhibit, Italy being famous for her lemons and oranges. In contrast to this show the Italian exhibit of olive oil was a fine one, though not very extensive. I was informed that there was much reluctance among the Italians to exhibit their goods, and hence the smallness of their exhibits.

If the Italian alimentary show was poor the agricultural show was, taking into consideration the importance of the country and the amount of agricultural exhibits sent, the very worst in the whole Exposition, showing nothing whatever of interest.

MONACO.

Monaco exhibited nothing whatever in Class 71, or in any of the classes of the eighth Group, but had a fine show of oranges, lemons, and other fruits and fruit trees.

Monaco, notwithstanding its small territory, furnishes some agricultural products of easy culture. Almost every small proprietor of land raises some crop or other, but the smallest particle of earth has to be utilized. The ground is steep and must be built up in terraces.

The olive is cultivated both for oil and for fruit, and a good show of the oil was made.

The lemon is the most important tree of the principality and flourishes particularly well there, growing perfectly in the open air, whereas at Nice it requires sheltering walls; the temperature of 3° C. below zero, which is fatal to the lemon tree, is unknown at Monaco. There are two principal varieties, the *serisqués* and *biguetés,* the latter being the finer. The lemons of Liguria, and particularly of the region between Monaco and Mentone, keep better than those from Naples or Sicily, and are thus better adapted for transportation. At Monaco the lemon is perpetually in flower, and bears fruit four or five times a year, the best fruit being that of the second or summer crop, while those of the autumn crop are the least fine. Formerly there was considerable exportation of the finest or *verdami* lemons to the United States, but now France is the principal exporter. The culture of the lemon demands but little care, a little manure being used every other year (horn scrapings, woolen

rags, animal manure, etc.), while pruning is done every year. Spotless lemons alone are exported, and sell at from 20 to 30 francs per thousand; the others are consumed in the country and bring from 5 to 10 francs; prices are variable and highest in the summer. For wrapping lemons, paper made at Genoa from old tarred rope is used. A single tree yields several thousand fruit in a year, and the culture is relatively easy and lucrative; the tree is, however, subject to several diseases.

The orange is also much cultivated at Monaco, the commonest variety being the yellow Portugal orange. Not only the fruit, but the flowers, leaves, and wood are all utilized. Other varieties, as the bitter orange, bergamot, and mandarin are grown, and the Chinese orange which is plucked green for preserving (*Chinois*). The temperature of —6° C. is fatal to the orange tree.

The carob-tree (*Coratonia siliqua*) grows wild at Monaco, and is utilized both for its fruit and its woods, the latter being hard and useful in cabinet-making. The fruit is not only a very valuable forage, but is used in pharmacy; it ripens in July to September. An exhibit of the fruit as a forage was made in one of the French sections. A certain culture of the carob by grafting is also carried on.

The fig is also cultivated, the dried fruit being an important item in the popular diet. The principal variety is the violet fig, which at Monaco gives two crops a year, one in early summer and one in September. Dried figs are much more used for ordinary food along the Mediterranean coast than elsewhere in France.

Monaco was one of the first countries to introduce the Australian *Eucalyptus globulus*. Many pharmaceutical preparations from the orange, carob, and eucalyptus were shown in Class 45. Wines were also shown, but there were no exhibits of viticulture.

NORWAY AND SWEDEN.

Norway had nothing in Class 71, though thirty-six exhibitors made a fine show in Class 70. In the Norwegian industrial section was a small exhibit of wheat, winter rye, vetches, linseed, clover, and grass seeds.

The culture of cereals has neither increased nor diminished in Norway during the last 30 or 40 years as to quantity, while the quality of the grain has been greatly improved; the use of fertilizers and of agricultural machinery has considerably increased. The number of cattle has not greatly increased, but their nourishment has been much bettered and forage plants are now more extensively cultivated; *colza* is much used for cattle in Norway.

Sweden had a very small exhibit, principally by tradesmen who brought their goods for sale, and showed nothing at all of agricultural interest.

PORTUGAL AND COLONIES.

The exhibit of Portugal was peculiar. Great attention was paid to two principal products, almost to the exclusion of everything else in the group. These two products were olive oil of which there were four hundred and twelve exhibits, nothing else whatever being shown in that class, and wine and liquors, of which there were no less than six hundred and eight exhibits. Notwithstanding this immense show of wines there was no viticultural exhibit beyond a few models of wine tuns. There was a small show of hoes, scythes, yokes, and plow-shares, containing nothing very remarkable.

In Class 71 there were only seven exhibits, consisting of preserved olives and other fruits, cherries. grapes, peaches, and pears, also of tomato paste, dried figs and prunes, all these being of good quality. No vegetables of any sort were shown, but there was one exhibit of wheat and three of good flour. One Lisbon house annually consumes 23,000,000 kilos of wheat, valued at 7,660,000 francs.

The agricultural exhibits of the several colonies were of a much better character than that of Portugal herself. There was a collection of the principal products of each colony exhibited by the Colonial Museum, at Lisbon, while the museum at Loanda sent collections from Angola, and in addition there were numerous private exhibits.

The Cape Verde Islands sent manioc, maize, and many vegetables. Manioc is one of the principal aliments of the colony, especially among the natives. Considerable quantities are sent to Lisbon. Maize is also much cultivated, good yellow and red specimens being shown. The vegetables exhibited were all of very fine quality, and comprised beans, peas, squashes, cucumbers, sweet potatoes, etc. Lucern was also shown, and many fruits, such as oranges, lemons, limes, bananas, dates, medlars, and cocoanuts, together with sugar, coffee, mustard, etc. Beans are one of the principal products of the colony, and were shown in great variety. Two sorts, the *pedra* and *bouge* are most usual, and bring from 35 to 50 centimes (7 to 10 cents) the liter. Sweet potatoes, also, are extensively used for food and also in distillation. Oranges are very abundant, especially at Santiago, but are mostly consumed in the colony, a few only finding their way to Lisbon or Hamburg A limited quantity is used for distillation. Coffee is abundant, and much is sent to Lisbon and other ports of Europe, where it is much appreciated. The Island of Fogo produces the best coffee, and from the whole colony about 500,000 kilos are exported annually. Sugar cane forms the largest crop of these islands. About 1,000,000 kilos of raw sugar are produced annually, half of which is exported, the price being from 30 to 40 centimes (6 to 8 cents) per kilo. Much brandy is distilled from the cane and sent to European ports. Cane vinegar is also made.

An important deposit of guano is found upon one of the lesser islands and is much exported, the price at Lisbon being 183 francs per 1,000 kilos. An analysis of this guano shows 14 to 15 per cent phosphoric acid, 5 to 8 per cent nitrogen, and 1 to 2 per cent potash.

The island of Madeira sent very little to the Exposition beyond its famous wines. There is, however, much agriculture practiced upon the island, and considerable exportation of vegetables, especially onions, cabbages, turnips, arrowroot, and sweet potatoes, is made; also of such fruits as the mandarin, cedrat, bananas, and pine-apples, these last commanding a high price at London. Orange and lemon trees have been introduced into the island, but do not now bear fruit so plentifully as formerly, so that exportation to England has ceased. Besides these, potatoes, beans, peas, and lentils, cucumbers, melons, carrots, beets, Egyptian yams, and other vegetables grow well, and many fruits, as the almond, peach, apricot (which becomes very aromatic there), pear, cherry, guava, and pomegranate. Strawberries may be eaten there from January 1 to November 1, and green peas grow the year round. The coffee grown in the southern part of the island is of easy cultivation and is said to rival Mocha, while the tobacco is a rival to that of Havana. Cotton is only grown as a curiosity. Wheat is of good quality (winter wheat), but the production is not sufficient for the wants of the population. Maize is imported from the Cape Verdes. Madder grows in abundance, while the castor-oil bean might be made a source of revenue were better attention paid to it. The sugar cane was formerly one of the principal crops of the island, but has given way to the vine. Since the ravages of the *oïdium* in 1852 the cane was resumed, but in 1885 a disease swept it entirely away and the vine again succeeded it. Sugar cane from Mauritius is now being introduced.

The island of St. Thomas and Prince Island, in the Gulf of Guinea, exhibited maize, rice, manioc, arrowroot, flour made from the bread-fruit, palm oil, and palm wine, cocoanuts, and cocoanut oil, coffee, sugar, spices, etc., and beans in great variety. The former island grows *cinchona* to a great extent, while the latter has large plantations of cacao, the exportation of which is estimated at about 380,000 francs. This industry has of late suffered severely from the invasion of hordes of rats.

Angola, upon the West African coast, exhibited wheat, sorghum, oats, barley, maize, rice, manioc, and tapioca, also palm oil, cocoanut oil, peanut oil, and many vegetables, as beans, in great variety, peas, fevès, sweet potatoes, mustard, sugar cane, etc. Caoutchouc is the principal export, its valuation being about 3,760,000 francs annually, coffee being next with a valuation of 3,000,000. Oil seeds, gums, waxes, cotton, tobacco, etc., are also exported, the whole being valued at about 9,500,000 francs annually.

Mozambique, the largest of the Portuguese colonies, sent maize,

rice, millet, dried manioc, peas, beans, salt, and oils. Much of its commerce is carried on with Zanzibar and Marseilles, its exportation being about 7,350,000 francs.

Goa, in Portuguese India, exports beans, fruits, spices, rice, tapioca, cocoanut oil, etc., samples of all of which were upon exhibition. Most of these go to Bombay, the annual value being about 5,000,000 francs. The new railway to the English frontier will undoubtedly tend to increase the agriculture and commerce of the colony.

ROUMANIA.

The agricultural exhibit of this country was a particularly creditable one and occupied a large and well filled section upon the Quai d'Orsay.

All products of the temperate zone thrive well in Roumania. In 1886 there were 4,255,132 hectares devoted to cereals, the product being, of all grains together, 54,031,919 hectoliters, thus divided:

	Hectares.	Hectoliters.
Wheat	1,129,685	20,918,850
Rye	237,420	2,681,994
Barley	608,814	6,580,284
Colza	26,123	189,224
Épeautre	267	2,132
Buckwheat	4,799	19,588
Maize	1,845,603	17,157,905
Oats	235,583	6,012,978
Millet	125,098	363,518
Hemp	14,457	102,571
Flax	27,257	101,745
Miscellaneous	26	130
Total	4,255,132	54,031,919

The mean annual exportation of cereals is 1,557,262 tons, valued at 198,948,052 francs.

A magnificent exhibit of the principal cereals was made and won from the jury a Grand Prix.

Maize is the principal cereal of the country and constitutes the staple diet of the rural population, and "in no country of Europe does it grow better or form larger ears." The appearance of the maize shown bore out this statement, and, except our American maize, no fairer samples were to be seen in the whole Exposition than those from Roumania and Servia. Several varieties were shown, the principal one being the Cinquantino of long ear and yellow grain; there was also a smaller variety of perfectly symmetrical ears and orange-colored grain, very transparent, and another of large, coarse grain; some white varieties of good quality were shown, but there were no red varieties. It is said that Roumanian maize is preferable to American, and that at Vienna 50 hectoliters of the former are sold for every 35 of the latter, the price of the Roumanian at Vienna being

from 8 to 9 francs per hectoliter. Maize forms rather more than half the annual cereal export of the country, most of it going to Austria, though much is also sent to France, Belgium, and Turkey. The greater part of this crop, however, is consumed in the country itself.

The climate of Roumania is particularly favorable to the cultivation of wheat, especially to hard wheats. The principal varieties cultivated are the Ghirca, Carnau, Banat, Sandomir, and the native wheat of the country. This last is particularly productive and is of large, heavy, and very farinaceous grain; its average weight is from 73 to 76 kilos per hectoliter and often reaches 78 or 80 kilos.

Rye and barley (Chevalier) are not so much used for food as they are for malting or for fodder for animals. The principal variety of rye is the St. Helena, and there is also a good native variety.

Oats, both black and white, are grown but are principally used for horses. Millet is cultivated both as an alimentary and as a forage plant, and sometimes a poor substitute for maize flour is made from it. Buckwheat is only grown in certain parts of Moldavia, the ordinary kind succeeding best; it is used both for men and cattle.

Hemp and flax are also grown, there being a native variety of the latter in the Dobrudscha. Colza is grown principally in Wallachia, and its cultivation has been much developed of late years; the variety exhibited was of Belgian origin. Hops are not yet regularly cultivated in Roumania, but grow wild there; besides their ordinary use in brewing they are eaten as a vegetable by the people.

Among the vegetables grown in Roumania are beans, both of the climbing and dwarf varieties; also fèves, peas, lentils, pumpkins, cabbages, onions, garlic, poireau, radishes, cucumbers, pimento, etc. Several good specimens of beans were shown, there being a small exportation of them. Beets are also cultivated, but only as a garden vegetable; experiments in raising sugar beets have, however, been made, and roots averaging 12 per cent crystallizable sugar have been raised successfully. Potatoes are not much eaten by the rural population, but are sent to be consumed in the towns or used for distillation. Carrots, turnips, egg-plants, tomatoes, celery, salads, etc., are grown in fields, while artichokes, asparagus, cauliflower, and brussels-sprouts are generally grown in the towns. Wild asparagus is also eaten. A custom prevails of planting climbing beans and squashes among the maize.

Watermelons are grown in the plains along the Danube and in newly tilled soils, and acquire considerable size and excellent flavor. Good chicory was also shown; the supply is not equal to the demand for it. Anise seed was also shown, and coriander, thyme, mint, and lavender are much cultivated.

Tobacco prospers well in certain portions of the country. In 1885 there were 5,610 hectares cultivated with tobacco by 15,177 persons,

the yield being 3,416,133 kilos. The native tobacco is of long broad leaf, and excessively strong, the best coming from Gaiesci, Bila, and Husii. Of late years foreign tobacco seed has been introduced, giving excellent results.

Among fruits the apple, pear, cherry, peach, quince, fig, almond, and walnut are cultivated, and many others, as the raspberry, mulberry, medlar, etc., are found in a wild state. The most important fruit of the country, however, is the plum, large quantities of which are cultivated for distillation of the national liquor, *tsouica*, a sort of brandy containing 40 per cent of alcohol. At the Exposition prunes were shown, dried in the ordinary way, and also some which, after sun-drying, had been preserved by subjection to wood smoke. The taste of these latter prunes is not unpleasant. The distillation of prune brandy is generally carried on in the mountain districts during the winter from prunes gathered in the autumn. Prunes are dried in large quantities, and kept whole or pressed into a sort of cake called *pistil.* Very few of the prunes are exported, and the samples exhibited by no means equaled those to be seen in the Servian exhibit. Many other fruits are also preserved by drying. The total fruit exportation of Roumania is about 12,000,000 francs annually in value. Many of the walnuts are sent to England.

RUSSIA AND FINLAND.

That portion of the galleries upon the Quai d'Orsay allotted to Russia was so taken up with the petroleum, sugar, and wine exhibits that very little space was left for anything else, and yet there were one or two agricultural exhibits worthy of mention. There was a fine collective exhibit of cereals from St. Petersburg, consisting of wheat, oats, buckwheat, beans, peas, linseed, melon seed, etc., and a domain belonging to the Countess Potocky also had a fine cereal show, including Champion, Danish, and Palavka wheats, early Polish and Welcome oats, and barley of very large grain, Bohemian mountain, Polish and Lithuanian ryes, etc., all of excellent appearance.

The house of L. Walkhoff, of Kalinofka, in southern Russia, also exhibited wheats as follows:

(1) One of the Hallett wheats, not specified, but which was found to excel all others in yield of grain (36 for 1 being obtained in 1887) and to have a very long straw not easily thrown down, but to be a tardy grower. It resists the rigors of a winter in southern Russia well.

(2) Trump succeeds well, resists the winters, and though its straw is less hard than that of the Hallett, it was not thrown down by the wind. The grain weighs 76.70 kilos per hectoliter, that of the Hallet weighing 74.

(3) Anglo-Russian or Russianized square head, completely acclimatized, has resisted eight winters at Kalinofka and can now resist a temperature of 30° C. below zero. It has somewhat degenerated from its English original, yet gives good yields.

(4) Noah is an excellent winter wheat, and is really of Russian origin, and was introduced thence into France; that exhibited was of large grain.

(5) Colossal or Bohemian mountain wheat, which has improved under the Russian climate.

(6) Nonette, a Swiss wheat of hard straw and large grain.

(7) Bamatka, a fine wheat of varying color and closely resembling Theiss wheat; has a soft straw and is easily thrown down; however, it resists the winters well and does not demand great care in cultivation.

(8) Kostromka, a good winter wheat of strong straw.

(9) Theiss, of Hungarian origin, and having grains of varying color, sometimes even party-colored; supports the winters admirably and is much used by the Russian millers, being greatly improved over its Hungarian prototype. Its straw, however, is short and thin, and it is easily thrown down.

All these wheats were cultivated for seed. The same house showed beet seed of superior quality and models of sugar beets. There was one poor exhibit of preserves from St. Petersburg, and another of dried raisins from Batoum. The sugar exhibit, however, was particularly fine.

Finland had no exhibit in class 71, and nothing of agricultural interest beyond one collection of cereals (wheat, rye, barley, oats, etc.), of fair quality, and a collection of curious and rather awkward looking spades and axes such as are used in the country. It had a small but fine show of Java sugar refined at Helsingfors.

Eighty per cent of the population of Finland is occupied in agriculture. A custom prevails of burning down the forests in order to clear the land for tilling, thus utilizing the ashes as a fertilizer, but wasting valuable timber. A part of the land is allowed to lie fallow each year, being cultivated for two or three years previously, and the introduction of a rational method of rotation of crops is only of recent date. The use of perfected instruments and of artificial fertilizers is becoming more general than it was a few years ago.

Rye is the principal cereal grown in Finland, and occupies 35 per cent of the arable land, barley occupying 14 and oats 12 per cent, the remaining 39 per cent being taken up by wheat, potatoes, garden vegetables, flax, hemp, grasses, and forage plants. Rye and wheat are sown in August, the seed sprouting in the autumn and remaining under the snow all the winter, and growing again in the spring. In the southern part of the country the rye is generally harvested in July. Barley and oats are sown in the spring and harvested after the rye.

There is also a custom of drying the cereals in a sort of oven or hot chamber before thrashing, or even sometimes of smoking them. Rye treated in this way is said to be very good, and to germinate and ripen much sooner than other sorts not so treated.

Finland does not produce cereals enough for home consumption, but is forced to import flour from Russia, though she sends seed rye to Russia and Sweden and seed oats to England. Cattle-raising holds an important position in Finnish agriculture, and large areas are devoted to grazing; but little hay is raised, however, and the cattle fare badly in winter, though of late great progress has been made in forage-raising in the south and west. Great pains have been taken by the Government to improve the stock by importation of foreign races, also to improve methods of butter and cheese making, dairy schools having been founded to this end.

SAN MARINO.

This small state had a small but very creditable exhibit of its agricultural products, which included beans, peas, maize of fair quality, millet, olive oil, honey and wax, and tobacco. Some wheat grains were shown 1½ centimeters long, and I understand that samples of this grain were taken for experiments in acclimatation in France. The vine grows well there, and good wines were exhibited. A few agricultural instruments of very crude description were also shown.

San Marino contains 60,000 hectares of land, one-eighth of which is rock; three-fourths of the whole is cultivated, half of it with cereals.

SERVIA.

Servia is essentially an agricultural country, and 90 per cent of its people follow this branch of industry; therefore it had a large and well prepared agricultural exhibit, and all its principal products were fully represented.

First in importance among its alimentary products were the dried prunes, of which there was a fine show, made by 33 exhibitors. Some of the prunes rival in quality the famous prunes d'Ente, of Bordeaux. Of all fruit trees the plum occupies the first place in Servia, and it is estimated that out of over 75,000 hectares of orchards existing in the country fully three-quarters are cultivated with this fruit. The drying of the prunes is generally performed in the ordinary manner by the fruit-growers themselves, and the total production is about 40,000,000 kilos per annum, the value of the yearly export being 15,000,000 francs. Belgrade is one of the principal markets for these prunes, and large quantities are sent to the United States and other countries. Prunes are also distilled to make slivovitza.

The Servian exhibit also contained beans, peas, lentils, and other dried vegetables, of which there was a large and varied assortment. The bean is the most generally cultivated vegetable, and forms a large part of the diet of the peasant. It is rarely cultivated in gardens, but in open fields, and often in the same field with maize, as in Roumania. Out of 138 exhibits in this class there are 87 of beans of various sorts. Peas and lentils are not very extensively cultivated.

Many other vegetables are grown in Servia, notably potatoes, onions, tomatoes, cucumbers, cabbages, eggplants, melons, and watermelons. A fine show of pimentoes was made. It is said that the peasants feed them to their cattle. Walnuts and large chestnuts were also exhibited, and there was a small collection of preserved fruits.

Servia made a particularly fine cereal display. Maize is the principal cereal of the country, and is extensively used by the peasants both for food for themselves and for forage for their cattle and swine. A little maize is also used for distillation. The maize exhibited was all of good quality and resembled that of Roumania, though not quite so fine. There were several varieties, the one generally preferred being a yellow maize of eight, ten, or twelve rows of kernels, which is relatively the most productive and contains the greatest amount of nourishment. This variety requires about 150 days for complete vegetation, and is not therefore adapted to the mountainous districts, but is replaced there by a smaller, yellow variety resembling the Italian pignalette. A large, white variety was also shown.

Wheat comes next in importance to maize, and is much exported to Austria and Hungary, and especially to Germany. France has also commenced to buy Servian flour, though as yet but little of it is produced. Winter and summer wheats are grown, and both were exhibited; of summer wheats there are two varieties, one red and one white. Winter and summer barley and naked barley (*Hordeum nudum*) are grown, the latter in small quantities only; also oats, épautre, buckweat, and millet. Épautre (*Triticum spelta*) is the least cultivated of the cereals and is only used for cattle as a succedaneum to barley. Buckwheat and millet are also given to cattle and poultry, the former being used to some extent in the household.

In 1888 there were 380,000 hectares sown with maize; 225,000 with wheat; 65,000 with rye; 65,000 with oats, and but 10,000 with épautre. About 14,000 hectares were sown with hemp and flax, the former predominating; other textile plants are not cultivated, although the climate is favorable to them. Experiments have been made with the sugar beet in certain localities, but its culture is not as yet extensive.

SPAIN AND COLONIES.

Spain had a large and rather good exhibit in Class 71, consisting of olives of superior quality, preserved cauliflower, tomatoes and pimentoes, etc., also of capers in vinegar; there was also a show of beans of many sorts, peas, lentils, hemp seed, turnip seed, canary seed, alfalfa seed, almond and other nuts. The cereal show was a good one, but in its show of olive oils Spain was entirely outdone by Portugal. Some of the weights of various cereals, etc., were stated as follows:

[Yield in kilos to the hectoliter.]

Bordeaux wheat	77.50	Maize	74.00–80
Catalan wheat	80.50	Rye	73.00–79
Flanders white wheat	76.00	Sugar sorghum	63.00
Jerez wheat	77.50	Millet	65.00
Seville wheat	83.00	Canary seed	86.00
Wheat in general	77.00–83	Beans	75.00–86
Australian barley	66.00	Peas	85.00–87
Ordinary barley	60.00–65	Lentils	80.00

Of the Spanish colonies Cuba sent cigars and tobacco, sugar and coffee; Rorto Rico sent maize, millet, rice, yucca flour, also starch, beans, peas, fruits, sugar in all grades, coffee, cacao, cinnamon, etc., and the Philippine Islands sent the same articles, also hemp and tobacco, both in leaf and as cigars.

SWITZERLAND.

This country had but a single exhibit in class 71, consisting of dried vegetables prepared for julienne, dried and ground potatoes, etc., of no great merit. There was no exhibit at all of cereals or vegetables, and but few of machines. In fact, the whole exhibit was poor in agriculture, when a much better show might have been made.

In 1880 there were 1,168,137 persons in Switzerland engaged in agriculture, being 41 per cent of the population; this shows an increase in numbers but a decrease in percentage since 1870, when 1,156,955 were so engaged, or 43 per cent. The amount of capital now invested in agriculture in the country is 3,420,000,000 francs, of which 570,000,000 are for buildings. The total yield of crops, cattle, etc., is about 400,000,000 francs. The area occupied by fields, prairies, and gardens is 2,143,000 hectares, pastures included, while vineyards occupy 34,530 hectares. The yield of cereals is estimated at 3,000,000 quintaux métriques, of a value of 70,000,000 francs, which suffices for about half the consumption of the country only. There are 4,600 Alpine pastures, or sufficient for 270,000 head of cattle, and the value of these pastures is about 77,000,000 francs, their yield being 11,000,000 francs. The viticulture of the country produces 1,150,000 hectoliters of wine, valued at about 45,000,000 francs. In 1888 there were exported 908,000 hectoliters, valued at 28,000,000

francs. There are 13,500,000 fruit trees, giving 3,500,000 quintaux of fruit, valued at 21,000,000 francs. Cattle insurance in Switzerland amounted to about 16,000 francs in 1888.

AFRICAN AND ASIATIC COUNTRIES.

EGYPT.

This country had one exhibit of dates, lemons, and pistachios, which were for sale in the bazaars. There was also a poor show of wheat, barley, fèves, peas, lentils, flour, sugar cane, and crude and refined sugar. No information was obtainable.

THE SOUTH AFRICAN REPUBLIC.

This enterprising country made a small but most creditable exhibit in a pavilion of its own upon the Quai d'Orsay. The Government at Pretoria sent a collective exhibit consisting of some particularly fine samples of wheat, épautre, oats, barley, rye, sorghum, peanuts, manna, and flour, also of fine dried beans and peas including a native variety of very small green peas, dried fruits, such as apricots, peaches, pears, and quinces, all of good quality, and, finally, of teas and coffees. A curiosity is root coffee (*Cappris albitrunca*) native to the country. Several private exhibitors also showed cereals, including maize, the latter being mostly white, with a few yellow samples, and all of it having an opaque look, though otherwise of fair quality. Maize flour (Indian meal) was also shown. Some of the wheat, especially the Bengal, was of very large grain, while the rye was even larger. Good leaf tobacco was also exhibited.

This Republic ought to be the granary of southern Africa, since no other part of that region possesses a soil better adapted for certain crops, but the agricultural population is too small, there being but 30,000 boors in a territory nearly as large as France. These boors only cultivate what is necessary for their own use, and as distances are great between the points of production and the market, as roads and means of transport are poor, and as water is often scarce, agriculture does not prosper greatly. Better railroad communication would greatly help it.

As to particular crops, cereals grow well in almost all districts and give two harvests a year. A Potchefstroom tobacco, the vine, fruit trees, and all vegetables of the temperate zone thrive well. In the northern part of the Pretoria district coffee and the sugar cane may be successfully grown. The district of Rustenburg is the richest agricultural part of the country, and besides cereals and the products above mentioned, tea, bananas, figs, oranges, lemons, almonds, and mandarins are cultivated; this last fruit there attains the size of an ordinary orange. Cotton and indigo are grown in some districts and good pasture lands are common. One district, Marico, produces fine peanuts.

Many of the above crops grow wild in certain places, as tea and indigo, also textiles; hemp also grows almost everywhere, but is hardly cultivated, its greatest use being by the natives for smoking like tobacco. Cattle are extensively raised, Angora goats doing especially well.

Notwithstanding this great fertility of its soil, the South African Republic does not produce enough cereals to supply home consumption, and is obliged to import from neighboring colonies and from Australia. In 1888 there were 34,795 kilos of maize and sorghum, 464,500 kilos of rice, and 2,790 of oats imported, as well as 301,450 kilos of flour, 766,132 of coffee, 2,334,725 of sugar, 126,300 of tea, and tobacco both in leaf and manufactured. Much traffic goes on with England, France, Holland, and Germany, and but little with the United States. Gold is the principal article of export, and after this hides.

JAPAN.

The ministry of agriculture and of commerce of this country, together with several private exhibitors, made very interesting exhibits of agricultural products, and some fine samples of rice, barley, wheat, and other grains were shown.

The exhibit in class 71 was particularly interesting; beside the Government exhibit there were fifteen private ones and eleven of these exhibits contained *soja* or *daizon.* The soja (*Glycine hispida*) is a leguminous plant closely resembling the pea, and is one of the principal vegetables in use among the Japanese, who employ it in various ways; *kôritôfou*, or cheese of the soja, is a sort of alimentary paste, prepared by coagulation and freezing. The soja is also grown to a small extent in France, and was exhibited in a collective exhibit from the département de l'Aube. Its grain contains very little amylaceous matter (starch) and sugar, and is therefore particularly adapted for food for diabetic patients, while it also contains much nitrogenous matter and phosphoric acid, which renders it very nutritive.

Another vegetable much used in Japan is the *azouki* (*Phaseolus radiatus*), a sort of bean. Dried prunes, *anzous* (*Prunus armeniaca*), were also shown and were of good quality. There was a fine exhibit of dried ginger. Raisins, nuts, peanuts, preserved bamboo sprouts, etc., were also shown, and the whole display was a good one.

PERSIA.

The Persian Empire had a small and very poor show of beans, peas, seeds, tobacco, opium, indigo leaves (but not manufactured indigo), cucumber seed, pickles, etc., with no catalogue and no information. A better exhibit was made of wines, but the whole Persian section

was more of a bazaar than an exposition, and the same might be said of the Egyptian, Chinese, and Indian exhibits.

SIAM.

In one corner of its section was a small exhibit of rice, very poor maize, beans and peas, and fruits preserved in liquid. There was no information to be had.

THE SANDWICH ISLANDS.

This country, exhibiting in a small but handsome pavilion of its own, had a fair display of its products, principally consisting of rice and paddy, and also of taro flour, while there were small exhibits of sugar, coffee, and tobaccc. The Hawaiian Archipelago contains 6,677 square miles of territory, being somewhat smaller than the State of New Jersey (7,445 square miles). The soil being of volcanic nature, and the volcanoes being still active, much of its territory is not available for agriculture; there are, however, 200,000 acres of cultivated land, of which 150,000 are well adapted to sugar-cane growing. By its climate the country is eminently fitted for cultivation, and, although great improvement might still be made, agriculture has made great strides since the introduction of civilization, in 1778.

The principal products of the country are sugar, taro, rice, and coffee, that of sugar being the most important. In 1889 there were 64 sugar factories, employing 16,000 workmen; in 1888 the production of raw sugar was 130,000 tonnes, the greatest part of which was sent to California for refining. (A reciprocity treaty between the United States and the Hawaiian Kingdom, concluded in 1876 and renewed in 1885, allows the free importation of raw sugar into the former country, whereas refined sugar pays high duties.)

Sugar-cane growing has been protected for the last 40 years only, the variety used being not the native one, but having been imported from Tahiti; it succeeds admirably, and by cultivation and change of locality has in reality become a new variety known as the Lahaina cane. As this variety needs a warm climate, and it was desirable to grow cane in colder climates, upon the mountain slopes, four new varieties of cane were imported from Queensland in 1884, and succeeded well at altitudes of from 300 to 500 meters (984 to 1,640 feet).

In 1886 the total exportation of raw sugar was 216,223,615 pounds, of which 216,211,002 pounds went to the United States, 10,663 to other islands of the Pacific, 800 to China, and 1,150 to Europe; in 1887, out of 212,763,647 pounds exported, 212,754,197,went to the United States, 9,200 to the Pacific, and 250 to China. Sugar residues, etc., are not distilled, the Government having determined to combat alcoholism by all possible means.

Rice culture in the archipelago is profitable, owing to the presence of 20,000 to 25,000 Chinese and Japanese coolies. In 1875 the exportation of shelled rice was 1,573,000 pounds, this figure having increased to 7,338,615 pounds in 1886 and 13,684,200 in 1887. Unshelled rice ceased to be exported in 1884. Almost all the rice is sent to the United States, a little finding its way to other Pacific islands. Hawaiian rice is of good quality but of limited cultivation, sugar cane being found more lucrative.

Coffee was formerly much cultivated, and that from Koua had a great reputation. In 1883 the total exportation was 16,057 pounds, almost the whole of which went to the United States, but the trees having been attacked by blight, the exportation nearly ceased, being only 1,675 pounds in 1885, this figure increasing in 1887, owing to a lessening of the malady, to 5,300 pounds. In 1888 in one plantation 50,000 coffee trees were replaced by sugar cane.

The *Taro* (*Arum esculentum*), almost unknown in Europe, is extensively cultivated among the islands of Oceanica and especially in Hawaii, where it is indigenous and is the principal aliment of the natives. From it is made the national dish, poi, which, it is claimed is "the most nourishing food in the world." It is not probable that its use will extend to other countries, although it is calculated that a field of taro a square mile in extent would suffice to nourish over 12,000 persons for a full year.

Of the less important crops, wheat was more or less extensively grown some 40 or 50 years ago, but is now hardly at all cultivated. Flour from the United States is cheap and other crops are much more lucrative. Tobacco is not regularly cultivated, but each private individual grows enough for his own use; it grows well, and has a large leaf, but is strong and rank. Much development might be given to this plant. Cotton has never been cultivated upon the islands, although a native variety is found wild there.

In 1845–1850 silk-worm culture was essayed in Hawaii; although mulberry trees flourished there, the *Morus nigra* being indigenous and the imported *M. multicaulis* doing well, a malady attacked the worms and the industry failed; the mulberry trees also have since suffered from disease.

The Government is at present occupied with a project to introduce the cinchona tree, and a plantation of 12,000 of the *C. robusta*, made in 1886, has had some success, and it is said that these trees contain more quinine than those of the same variety grown in India or Ceylon.

Among the agricultural exhibits was a series of handsome photographs of the Woodlawn Dairy and Stock Company, illustrating their cattle, which include Jerseys, Holsteins, Durhams, Devons, and Ayrshires. This is the largest dairy in the Kingdom, and has a capital of $100,000; over 200 cows are milked there twice a day. American influence was visible in this dairy's exhibit as well as everywhere else in the Sandwich Island pavilion.

THE AMERICAN NATIONS.

One of the leading features of the Paris Exposition of 1889 was the unanimity with which the various countries of the Western Hemisphere responded to the invitation of France to be present and to exhibit their wealth and industries for comparison with those of the Old World.

From North America, Canada alone was without representation, while from Central and South America every State, without exception, even to the smallest and poorest, was represented with more or less completeness; and not only this, but, with the three exceptions of the United States, Peru, and the United States of Columbia, every American nation had its own separate building upon the Champ de Mars, and several of these buildings were among the largest and most important at the Exposition, and contained some of the finest exhibits. Among all these, that of

THE ARGENTINE REPUBLIC

certainly held the first place, and well merited the large number of prizes awarded to its exhibitors. It is stated that this Republic spent $600,000 upon its building and exhibit.

This country made a large and interesting alimentary exhibit and a particularly important agricultural one.

Of the one hundred and sixteen exhibitors in Class 71, eighty-six or about three-quarters showed beans of all sorts, which seem to be the principal market vegetable of the country; these were all of good quality. There was also a good show of the gesse, or Spanish lentil (*Lathyrus sativus*), of which several varieties are known in France, both as food and as forage plants. Other vegetables shown were peas, including green-peas and pois chiches, lentils, fèves, turnips, and even pumpkins; several exhibits of preserved fruits and vegetables were also made, including apricots, peaches, pears, pineapples, and medlars; also asparagus, artichokes, celery, chicory, cauliflower, and tomatoes; among these were preserved green corn, being the only samples to be found in the Exposition except in the United States exhibit. Dried figs, prunes, and raisins, also cultivated and wild nuts, were shown; peaches were shown dried both with and without their stones. There was one exhibit of olives and two of olive oil. The culture of the olive is only about a year old in the Republic, and has not attained greater development hitherto, though a few olives have already been exported.

A good show was made of peanuts; one variety was peculiar, being of large size with a deep orange-colored shell. Peanut oil was also shown.

Owing to an accident very few potatoes were exhibited, but those shown were of very good quality. In 1870 no potatoes were ex-

ported; in 1880 the exportation amounted to 200,000 kilos, and in 1885 to 500,000 kilos, all going to Brazil and Paraguay, and none to Europe. The principal use of potatoes in the Republic is for distillation; much alcohol is also made from peaches. Maté, or Paraguay tea, was also shown; the consumption of this herb in the country is about 10,000,000 francs annually in value, but is slowly decreasing among the upper classes, giving place to tea.

The agricultural exhibit of Class 67 comprised no less than seven hundred and forty-three exhibitors, most of whom sent wheat. There were some magnificent samples of this; the principal variety being Barletta wheat, weighing 76 to 83 kilos per hectoliter; one sample was shown weighing 86 kilos. Other wheats were the Touzella, weighing from 75 to 83 kilos; Richelli, 76 to 80 kilos; Candéal, Saldomó, and a variety of French origin of a similar weight. A plant of the Saldomó wheat was shown bearing 79 heads, and another of 62 heads, from a single seed. In 1888 there were 600,000 hectares sown with wheat, 410,000 of these being in the province of Santa Fé, the principal cereal-producing district, while the province of Buenos Ayres came next, with 158,000 hectares. The exportation of wheat in that year was 178,910,000 kilos, a diminution of 58,955,925 kilos from 1887. Up to 1870 the Republic was obliged to import wheat. From 1870 to 1878 wheat production was sufficient for home consumption, and since 1878 home consumption has been exceeded, so that at present wheat is an important article of exportation.

Next in importance to wheat comes maize, many excellent samples of which were shown. White maize is the commonest and some of the samples weighed 75 to 80 or even 82 kilos per hectoliter; next came yellow maize, weighing 80 to 85 kilos; samples of Cinquantino, Quarantain, Dent-de-Cheval, Guinea, and red maize were also shown. The average yield is 25 to 35 hectoliters per hectare. In 1888, 386,000 hectares were planted with maize, and 160,020,499 kilos were exported, being less than in 1887, when 201,823,806 were exported. This all goes to Germany, England, and France, Rouen and Dunkirk being the principal ports for its entry into the latter. It is also the principal dry fodder for horses in the Republic. Cinquantino maize is much used for distillation. Maize is indigenous to the country.

Other grains exhibited were barley, weighing from 50 to 70 kilos per hectoliter, one or two samples reaching 80 kilos. White and black oats, weighing 45 to 60 kilos, and rye 70 to 73 kilos. Barley is much cultivated for malting, the French Orge Chevalier being the seed used, and the native variety being very little sown. Millet, some good samples of which were shown, weighs from 65 to 75 kilos. Canary-seed and a little rice were also shown.

After wheat and maize the most important agricultural product of the Argentine Republic is linseed, of which samples were shown

weighing 64 to 67 kilos per hectoliter. This grain usually does well in the Republic, and in good years the average yield is 2,000 kilos per hectoliter, while in France it is only about 630 kilos; since 1886, however, a disease has attacked the plant and the yields have been much less, with a consequent falling off in exportation. In 1888, there were 40,222,888 kilos of linseed exported, against 40,985,288 in 1887. Very little use of flax as a textile fiber is made, the plant being particularly cultivated for its seed, most of which goes to England and Belgium.

The annual exportation of peanuts from the Republic averages 770,000 kilos, of the value of about 150,000 francs; nine-tenths of this goes to France.

Several specimens of dried and baled hay and lucern were among the exhibits. The latter is an important crop in the Republic; is cultivated almost everywhere and in certain provinces yields three crops a year; Brazil takes most of the lucern exported, having in 1888 consumed 12,000 tons out of 12,400, the total export. Brazil and Paraguay also take all the potatoes coming from the Republic; 500,000 kilos in 1885.

The culture of cotton was attempted in the Republic, but abandoned, probably on account of its expense, though it throve well in several districts. Tobacco meets with better success, especially in the provinces of Corrientes and Cordoba. North of the 28th parallel the sugar-cane may be successfully cultivated. Oranges and lemons may also be grown in the country.

"Lands being still quoted at relatively low prices, agriculture is rather extensive than intensive in the Republic, and as much space as possible is utilized even though the soil is imperfectly prepared. The use of fertilizers and systems of rotation are scarcely known there, and manual labor being scarce and dear machines are constantly employed, being let out to the colonists in certain localities; machines of all kinds are used."

Mr. Woodman, in his report on the Exposition of 1878, states that the quality of the wheat there exhibited by the Republic was inferior to that of Australia or the United States, probably on account of the low standard of agriculture then prevailing. The standard would seem to have greatly improved in eleven years, for the samples of wheat shown in 1889 were of excellent quality, and compared favorably in weight with those in the French Exhibit.

BOLIVIA.

This country was represented for the first time in its history at an International Exposition, and had a handsome pavilion upon the Champ de Mars. A good alimentary exhibit was made, which presented some specialties of the country, as follows:

Chuño is a general term for vegetable substances preserved by

cold, and several samples were shown, the most common variety being made from potatoes. These are evaporated nearly to dryness by the sun's heat, in the valleys where they are grown, and are then transported to the mountain heights and there exposed to great cold. After this freezing the skin easily falls off and the potatoes are preserved for a long time. Their taste is insipid and they are not much appreciated by the whites, but are much sought by the Indians, and are also a staple diet for the army. Some of the samples shown were snow white, while inferior varieties are generally gray or black. Chuño is also made from bananas, oca, and other vegetables. The whole of South America is a fine potato-growing country and many kinds are found there, but unfortunately but few were shown at the Exposition.

The *Oca* is a tuber related to the sorrel (*Oxalis crenata*). It was introduced into England in 1829 and rapidly spread over Europe. It is a native of Peru and other South American States and is very common in Bolivia. It differs essentially from the potato to which it has been erroneously compared. Several samples of the dried tuber were shown in the Bolivian pavilion, its taste being somewhat like that of the chestnut.

Bolivia exhibited some good cereals, maize being the most common. All sorts of maize are shown, principally white or yellow varieties, some of the former being of very large grain. There were also blue and violet as well as red varieties, and one sample was of so dark a red as to appear black. Maize is the principal food of the Indian tribes, though the whites also use it. A sort of native beer, *chicha*, is also brewed from it, especially from this black variety. Some of the maize has a dull opaque look frequently seen in tropical varieties (see Ecuador), but most of it was of very fair quality. Maize has long been known in Bolivia, and is probably indigenous there.

Good wheat was also shown, *Barba roja* and Mexican wheat being the principal varieties; also barley, rice, sweet potatoes, beans, peas, fèves, and some large-sized peanuts; these latter are sometimes mixed with maize in making chicha. Bolivia produces but little wheat flour, importing its supply principally from Chile. Some native flour is made from the yucca.

Besides the above, a native oleaginous grain, *Quinua*, was shown in several varieties; it is used like tapioca and is said to be very nourishing. Another similar grain is the *Canagua*, much smaller in size. Another native product is *Acuguayaco*, or "bread of heaven," which is not cultivated though much appreciated. Beans, especially a large kind of fève, are roasted and eaten like chestnuts. Preserved fruits, as apricots, figs, peaches, quinces, and strawberries, were shown, made into solid pastes. There was also an exhibit of edible pine cones, yucca root, cacao, cocoa leaf, and coffee; the latter was

of fine quality, but is somewhat unknown and dear; a little of it finds its way to England.

Modes of communication are difficult in Bolivia, and therefore there is but little exportation.

BRAZIL.

This country made a fine exhibit of alimentary products, consisting of beans of various sorts, with flour made from them ; manioc, with tapioca and manioc flour ; rice, and rice flour, wheat, and wheat flour, maize, and Indian meal, arrowroot, etc. In Class 72 the exhibit was very large, comprising three of the most important products of the country, coffee, cacao, and sugar, besides which other products were shown, as vanilla, peanuts, spices, preserved fruits and vegeta- of many sorts, etc. Other than these the agricultural products were few.

There are four principal plants which constitute the chief alimentation of the people of Brazil: Manioc, maize, rice, and the black bean. Manioc grows easily in dry sandy, tropical soils, and without much care may yield as much as 150 hectoliters to the hectare ; this plant as well as maize was cultivated by the natives in America before the time of Columbus. Rice is much grown in the valley of the Amazon and other low-lying districts, while the bean is cultivated almost everywhere; sweet potatoes are very common in Brazil, and a much used root is the Igname or yam (*Dioscorea*).

The most important product of Brazil is coffee, while cacao, caoutchouc, sugar cane, cotton, and tobacco are all of great importance. A very extensive show of Brazilian woods was also made.

Wheat culture is very ancient in Brazil, but has only recently attained much importance. Previous to 1830 wheat was principally grown in the south only, but now much attention is given to its introduction all over the country, and wheat flour is tending to replace the less nutritious manioc flour. Much attention is also paid to viticulture.

CHILE.

A Government exhibit heads the list with a show of farinaceous vegetables, as beans, fèves, green peas, pois-chiches, lentils, dried prunes, cherries, raisins, and peaches, also nuts. Beans seem, as in other countries, to be the most important vegetable. Dried figs, almonds, and a few preserved fruits are also shown. Dried peaches and raisins seem to be a staple article, and the exhibit of them is fine.

Chile also shows good wheat and fairly good maize; some of the latter is of large grain and opaque. The country annually produces about 10,000,000 hectoliters of wheat and 3,000,000 of other cereals, with a corresponding proportion of vegetables and fruits.

In 1888 the exportation of wheat, either as grain or flour, amounted to $8,784,363 (Chilian dollars=$8,623,608 United States currency), being 12 per cent of its total exportation, or $3.48 (Chilian) for each inhabitant.

THE UNITED STATES OF COLOMBIA.

The United States of Colombia made a small exhibit of coffee, cacao, coca-leaf, and cinchona in one corner of the gallery of the Uruguay pavilion.

COSTA RICA.

This country did not open its exhibit until September 21. It had a small show of good coffee, cacao, sugar, and cereals.

THE DOMINICAN REPUBLIC.

Agriculture has received considerable impetus in this country during the last few years, and is now the principal occupation of the inhabitants. Two thousand seven hundred square leagues of land are under cultivation, and are fertile and well watered.

The principal crops cultivated are as follows: Tobacco occupies the first place and is indigenous. It is cultivated everywhere, and is generally of good quality and produces the largest size leaf known. Some of it rivals the finest Cuban tobacco, and much is exported to Belgium, Holland, England, and the United States. Two harvests are gathered yearly. In the last seven years, 1882-1888, 783,238 quintals were exported.

Coffee occupies second place and grows well in all parts of the island. Great care is taken in its cultivation, the results being that it is much appreciated. From 1881 to 1887 22,895 quintals were exported. Cacao is a native of the island, and is much cultivated. From 1881 to 1887 the exportation was 43,467 quintals. A new plantation of 80,000 trees has lately been established. A custom prevails of drying the cacao in its pod and exporting it in this condition, thus preserving its aroma and qualities. Cacao so dried was exhibited, as well as some magnificent samples of coffee and of tobacco.

Cotton is native to San Domingo, and grows well there even without any care, though its cultivation is also extensive. The culture of sugar-cane is increasing, and some good samples of sugar were exhibited. Sesame, rice, and a little maize, also bread fruit, were shown.

ECUADOR.

Notwithstanding "the notorious state of decadence that this country is in as regards agriculture and industry despite the richness of her soil," as stated by a certain journal, Ecuador made a fine, though small, show of her products and obtained several gold medals for them, besides one Grand Prix.

There was a good show of beans, pois-chiches, yucca, sweet potatoes, wheat, barley, maize, rice, pimentoes, coffee, sugar cane, indigo, and vanilla; also a good show of medicinal plants, such as cinchona, sarsaparilla, tolu balsam, ipecacuanha, copaiba, valerian, etc., etc. (including the native plant *guaco*, used by the Indians as an antidote to the bite of the rattlesnake). There was also a show of fruits such as pineapples, oranges, pomegranates, mangoes and sapodillas. The best display, however, was that of cacao, which seems to be one of the staple products of the country.

The maize which was exhibited presented some peculiarities; one variety was of a dark-red color and of large grain; another was blue, and there was a very large yellow variety, and a still larger white one with grains nearly an inch long; the samples were coarse in texture and had a peculiar dull look, noticeable in all maize exhibited from tropical climates.

GUATEMALA.

This country made a fine exhibit of its products, but more especially of its coffee and cacao, for which a special *chalet de degustation* was installed. Other products shown were tobacco, indigo, sugar in all stages of manufacture, from the cane to refined white sugar, textiles, including samples of ramie 8 feet long, spices, etc.

Wheat, barley, rye, oats, and maize were shown, all of excellent quality. The maize was yellow and some of it was fine. Rice and linseed were also shown.

Beans, both black and white, onions, preserved fruits, and dried bananas were exhibited; these last are dried whole in their skins by simple exposure to the sun, and are not exported.

Peanuts of good quality were shown, also wild coffee, a sort of succedaneum for coffee, which it does not in the least resemble, but like which it is roasted and ground. The wood of the coffee tree is utilized for cabinet-making, and some fine furniture made from it was exhibited.

Thanks to its different climates the vegetable products of almost all zones are found in Guatemala. The fertility of the high plains is very great, and maize (which grows two or three crops a year), wheat, barley, rice, farinaceous vegetables, fruits, potatoes (which, however, were not exhibited), sweet potatoes, manioc, sugar cane, indigo, tobacco, cotton, pepper, vanilla, etc., etc., are there cultivated. The two products constituting the principal wealth of the country are cacao and, especially, rice; caoutchouc should also be noticed.

The commerce of Guatemala has greatly developed within the last few years, especially as regards coffee. In 1868 only $1,840 worth of coffee was exported; in 1873 this had increased to $2,408,106.

The coffee crop of 1889 will much exceed 600,000 quintals, representing a value of over $14,000,000. In 1888 the coffee harvest was 588,440 quintals, and in the same year the value of the sugar exported was $308,830; caoutchouc, $88,448; bananas (not dried), $56,704.

HAITI.

Being engaged in civil war during the time of the Exposition Haiti made no national exhibit, though five mercantile houses united in sending a small but brilliant collective exhibit of the products of the island in which they deal. Most of this display consisted of coffee, which was magnificent in quality; good cacao was also displayed, and cotton, campeachy seed, hemp and hemp seed, castor-oil beans, and rum. One of the coffee plantations was illustrated by fine photographs. Haiti is said to export annually 80,000,000 pounds of coffee.

HONDURAS.

Mr. P. Abadie, the French consul at Honduras, made nearly the whole exhibit of this country, showing the products of his large plantation there. There was some particularly fine coffee of large grain, some of which was shown on the branch. Sugar cane, tobacco, ramie, indigo, and ebony-wood were also shown, together with photographs of the plantation.

MEXICO.

The Mexican exhibit was a fine one, and included farinaceous vegetables, as beans of many sorts, peas, pois-chiches, fèves, gesses, and lentils; also potatoes, sweet potatoes, onions, and garlic; and many dried fruits, such as figs, raisins, dates, apples, quinces, peaches, and finally tamarinds, cocoanuts, pistachioes, various nuts, etc.

The following list of yields of the farinaceous vegetables is official:

		Kilos.
Beans	19 to 40 hectoliters per hectare; 1 hectoliter=	75 to 80
Fèves	24 to 48 hectoliters per hectare; 1 hectoliter=	70 to 75
Lentils	8 to 20 hectoliters per hectare; 1 hectoliter=	78 to 80
Pois-chiches	12 to 30 hectoliters per hectare; 1 hectoliter=	78 to 80

Market gardening is well developed, and almost all the most usual vegetables are grown around the city of Mexico.

In Class 67 the exhibits included wheat, barley, rice, maize, rye, alpist, millet, linseed, together with flour, Indian meal, sago, yucca flour, and potato starch. Some of the maize was of large grain,

and most of it was of the white variety, but none of it was particularly fine. Some of the yields stated were:

		Kilos.
Wheat	8 to 27 hectoliters per hectare; 1 hectoliter=	78
Maize	18 to 45 hectoliters per hectare; 1 hectoliter=	72 to 75
Barley	8 to 22 hectoliters per hectare; 1 hectoliter=	65 to 68
Rye	25 to 30 hectoliters per hectare; 1 hectoliter=	70 to 72
Rice	2,600 to 4,000 kilos per hectare; 1 hectoliter=	48 to 50

Besides the above, coffee, sugar, cacao, both wild and cultivated, ginger, vanillla, coriander seed, spices, etc., were shown in great variety; the whole show being a good one. There was also a good collection of wax models of fruits. Vanilla is native to Mexico, grows wild, and is the variety most esteemed in foreign markets.

The annual value of the principal agricultural crops is as follows:

	Piasters.
Maize	110,000,000
Wheat	18,400,000
Cotton	10,857,000
Sugar	*8,735,000
Beans	8,000,000
Barley	4,500,000
Hennequen	3,718,750
Coffee	3,200,000
Tobacco	2,500,000
Rice	1,246,000
Cacao	1,135,360
Peas	950,000
Vanilla	900,000
Potatoes	600,000
Fèves	500,000
Indigo	372,910
Sesame	200,000
Cochineal	111,910
Lentils	100,000
Other articles	1,460,000

making a total of 181,131,930 piasters. (A Mexican piaster is equivalent to 85 cents United States currency.)

In 1886 the principal agricultural exports of interest were:

Coffee	$553,684.86	Fruits	$40,373.01
Vanilla	282,812.00	Caoutchouc	39,146.67
Tobacco	192,268.96	Beans	29,905.57
Sugar	58,890.50	Peas	5,769.27
Anise	56,132.50	Cacao	2,066.66

NICARAGUA.

This country made a good display of black and white beans, rice, manioc flour, almonds, etc. The maize was of good quality and

* As cane or raw sugar.

mostly yellow, though there were white and dark red samples. Sweet potatoes and manioc root were not shown, though they are staple products.

The principal exhibit was in Class 72, where, out of one hundred and seventy exhibitors, one hundred and twenty-two showed coffee of excellent quality, forty-five showed cacao, and three showed sugar.

A national beverage, *tiste*, is prepared from cacao and maize, and is drunk like chocolate.

The resources of Nicaragua are as yet entirely undeveloped, but great progress is to be expected upon the opening of the new canal. Large quantities of coffee are grown in the hilly regions of the northwest, while Brazil wood grows in abundance in the forests, and between the lakes and the Pacific there are many plantations of indigo, cacao, and sugar. Potatoes and maize thrive in the upland regions of Segovia. The region to the east of the lake is a great grazing country, supporting thousands of cattle. The forests produce caoutchouc, cedar, mahogany, and dyewoods, while in all sections maize, plantains, oranges, limes, bananas, and many other fruits grow in abundance.

PARAGUAY.

The Government sent a collective exhibit of vegetables and fruits, which, however, was not very remarkable. The most noteworthy exhibit was that of maté, or Paraguay tea, which is shown packed in its original skins, and might be tasted at the pavilion. It forms the object of great interior commerce and of considerable exportation. Tobacco, tan-barks, and medicinal plants were also shown.

Paraguay is a wonderfully fertile country, and might have a brilliant future were it better known. Two inscriptions upon the pavilion were to the effect that "Paraguay is equal in extent of territory to France," and that "The commerce of Paraguay is 40,000,000 francs per annum."

PERU.

This country, being crippled by her late disastrous war with Chile, made but a very small exhibit, in one corner of the Uruguay building. Coca-leaf was the principal product shown, besides which there were samples of coffee, cacao, sugar, and rice, the samples shown all being of good quality.

SAN SALVADOR.

This country sent a number of exhibits of beans, peas, fèves, and chestnuts; also of caoutchouc, coffee, indigo, castor oil, leaf tobacco, wax, peanuts, etc.

URUGUAY.

This country exhibited farinaceous vegetables, as beans of several varieties, peas, lentils (a variety of the latter being of Castilian origin), flageolets, Spanish peas, fèves, turnips, almonds and other nuts. Preserved fruits, as oranges, pears, and melons were shown; also peas and beans preserved in liquid in their pods.

There was also a good exhibit of cereals, including American, Lombardy, and Spanish wheats, English barley, Cinquantino and Guinea maize, buckwheat, linseed, hemp seed, millet, canary seed, etc. The Cinquantino yellow maize was of good quality, but the white maize had an opaque appearance. Good coffee and sugar were shown. The tobacco had a very black and rank look.

Uruguay is an essentially pasturing country, but of late years agriculture has been increasing and somewhat rivaling the raising of cattle. Twenty years ago Uruguay imported much of its cereals from Chile and the United States, but now agriculture has so advanced that the excess of cereals is exported. The wheat of Uruguay is reported to be the best in South America, yielding 10 to 15 for 1, while maize yields 300 for 1, and barley 18 to 36 for 1.

All cereals and fruits of the temperate zone grow well in Uruguay, and give satisfactory yields. Potatoes give two crops a year, and the crops of 1876 and 1877 were each of 1,200,000 hectoliters of wheat and 8,000,000 of maize.

VENEZUELA.

This country had two rather important exhibits by state and city commissions, consisting of beans, fèves, lentils, peanuts, cocoa, olives, and breadfruit. There was also shown maize of good quality, rice, potatoes, yucca root, millet, etc. A very miscellaneous collection of products of the country was also shown, including tinctorial barks, medicinal plants, caoutchouc, india rubber, coca, tonka beans, vegetable ivory, bat guano, vegetable musk, waxes, etc.; also wild-tobacco seed, which is collected for cultivation. Good specimens of coffee, cacao, palm oil, castor and cocoanut oils and ginger were also shown.

CHAPTER II.

CLASS 73 BIS.—AGRONOMY; AGRICULTURAL STATISTICS.

By C. V. RILEY.

Studies concerning waters, soils, climates, and rural populations. Divisions of lands and cultivations.
Agricultural statistics; agrological, hydrographical, climatic maps, agronomic maps. Tables, plans, models.
Agronomic stations; agricultural laboratories.
Agricultural syndicates, societies and meetings.
Institutions of credit, charity, of protection for rural population; mortgage companies; agricultural banks; people's banks; coöperative insurance; savings banks, etc.
Legislative measures; rural code; special laws.
Official agricultural administration: works and publications; agricultural missions.

FRANCE.

As far as actual exhibition of work was concerned there was hardly anything to be seen in this class beyond the very complete expositions made by the French agronomic stations and agricultural laboratories, as well as by societies and syndicates. As far as statistics, studied upon the soils, waters, climates, etc., were concerned, documents relative thereto were to be found almost everywhere upon the Quai d'Orsay, especially in Class 73 *ter* among the exhibits by the made ministry of agriculture and the schools.

INSTITUTIONS OF CREDIT.

As to the institutions of credit, of charity, of protection for rural population, etc., the Exposition showed almost nothing upon such subjects, for the simple reason that nothing of this sort, attached especially to agriculture, exists in France. Neither do agricultural banks exist, though a strong popular opinion has prevailed in France of late years in favor of agricultural credit, and it is not too much to aver that before long agricultural savings banks and institutions for such credit will be formed upon a substantial basis. A *Commission de Crédit Agricole* has been in operation at the ministry of agriculture for several years, and in 1888, upon the proposition of the then minister, M. Viette, a law was passed restraining the privi-

lege of proprietors with a view to giving better warranty in the supplying of seeds and the fertilizers.

Questions of agricultural credit, rural assistance, and kindred subjects were discussed at the International Agricultural Congress held during the Exposition, a report of which will be found among these pages (Chapter x).

Professional agricultural Syndicates, organized in virtue of the law of March 20, 1884, have attained considerable development in France, and since the first one of these, that of the Department of Loir-et-Cher, was founded, in 1885, over six hundred have come into existence. Most of these limit themselves to the purchase in common of complete fertilizers or crude fertilizing materials, seeds and other supplies, at greatly reduced prices, and to the dissemination of information as to their use; others have undertaken the selling of grain, cattle, or other products by mutual combination. In several Departments (Lozère, Jura, Oise, and others) such syndicates have attempted the organization of agricultural credit, such as exists in Italy or Germany. Many syndicates publish weekly or monthly bulletins, while others create laboratories and analyze the soils of their districts, or use means of defense against injurious insects, etc. In 1888 there were in France 766 special syndicates for defense against the Phylloxera, comprising 25,000 proprietors and treating 32,680 hectares of vineyards. The protection of vines from early frost by means of artificial clouds is also undertaken by syndicates.

French cultivators have thus a powerful weapon in their hands, though some of these syndicates may, perhaps, have a dangerous tendency in grasping at too wide a field of application. Those which specialize their operations have the most assured future.

About fifteen of these associations took part in the Exposition in making known their statutes and the importance, as large figures testified in most cases, of their operations. Among these numerous associations the syndicate of Govron (Mayenne) deserves especial notice; it was organized with a view to *hannetonage*, or defense against the cock-chafer (*hanneton*) and other harmful insects, and was the first society to take steps in common defense. It was inaugurated in conformity with a law which gives the prefects all powers for prescribing necessary measures for arresting or preventing damage to the crops by insects. The idea of a common defense, it is true, had already been embodied in a law upon the Phylloxera.

Following the initiative of M. Le Moult, inspector of highways at Govron, this syndicate collected and destroyed in the canton during the year 77,000 kilos of cock-chafers, paying therefor 8,025 francs.

AGRICULTURAL SOCIETIES.

Agricultural associations are formed by landowners and cultivators and have for their object the improvement of agriculture by

experimentation, the encouragement of new methods and useful inventions, etc., since they recognize that "in agriculture isolation is weakness and sterility, while association is power and productiveness."

The first of such associations dates from the reign of Louis XV, the *Société d'Agriculture de Rennes* having been founded February 2, 1757. Societies were also founded during this reign at Paris, Limoges, Rouen, Lyons, Orléans, Bourges, Alençon, and Auch.

The most important of these was that of Paris, founded March 1, 1761, which was transformed later into the *Société Nationale d'Agriculture de France*. This is an elective society, and counts among its members the shining lights of the agricultural world. The late M. Chevreul, the eminent chemist, who died in April, 1889, at the age of 103 years, was for 30 years its president. The society consists of 52 titular members, 15 foreign members, and 40 national associate members, also of 170 corresponding members for France, Algeria, and the Colonies, and 50 corresponding foreign members. In short this society is equivalent to the *Academy* of Agriculture. Memberships of titular and foreign members as well as those of national associates are only confirmed upon approval by the President of the Republic upon representation made to him by the minister of agriculture, who is honorary president of the society. Correspondents are nominated by the minister, and the presence of 27 titular members is necessary for the validity of all elections.

The society comprises eight sections: Grand culture, special culture, sylviculture, animal economy, agricultural physics and chemical science, agricultural natural history, agricultural mechanics and irrigation, and agricultural economy, statistics and legislation. It possesses the magnificent domain of Harcourt (Eure) and its benefits to the public are recognized. It is specially instituted to answer demands of the Government, and to enlighten the same upon every point of interest in the progress and development of agricultural industry. It also has for its mission the study of all questions relating to rural legislation and economy; to examine, value and test new discoveries and processes in connection with various branches of cultivation or cattle-raising; to study the diseases of plants and of animals; to discover methods for the destruction of insects injurious to crops, and to preside at competitions for the reward of authors of new and useful discoveries, or of memoirs upon important agricultural subjects. The society publishes a monthly bulletin and an annual report of its work and of such memoirs as it has approved of.

The *Société des Agriculteurs de France*, founded in 1869, comprises more than 4,000 members, and is the most powerful of all the agricultural societies. It takes an active part in discussing all prominent agronomic questions and in advocating improvements and measures of reform.

The twentieth annual session was held in Paris from June 24th to 30th, and a short summary of its proceedings may give an insight into the society's work, as well as an idea of French agricultural matters in general. After the reading of a review of what has been accomplished since 1879, and also of the treasurer's report, which showed the society to be in a flourishing condition, the following were among the subjects considered and resolutions passed: (1) A report upon the revision of the tariff as applied to products of agriculture was submitted, accompanied by a comparative table of tariffs in various countries. (2) A resolution passed by the agricultural Society of the Department of the Vaucluse was discussed and adopted. This resolution was to the effect that the Government should further by all possible means works of hydraulics and irrigation, and that especially in the said department measures should be taken to restrain the waters of the river Durance; also that irrigation works already begun should be completed, and that a law should be projected for the immediate construction of canals from the Rhone. (3) A petition was produced bearing the signatures of 22,000 inhabitants of the Departement du Calvados and presenting fourteen resolves concerning commercial treaties, customs duties, the purchase exclusively in France of horses and other supplies for the army, and other similar matters. (4) Reports were also submitted concerning division of property, and the necessity of allowing a father to designate one child as his successor in the tenure of land.

The resolutions or *voeux* of the society were as follows: (1) That the imposition of supplementary taxes be suppressed, and that married women, minors and incapables be allowed representation by proxy. (2) That the laws concerning vagabondage be rigorously enforced, and that public rural assistance be reorganized. (3) That the society encourage the creation by syndicates of mutual companies for insurance against fire, accidents, hail, and mortality among cattle, at the same time that the society cause the study of a reserve bank destined to support such companies. (4) That existing commercial treaties of which the terms expire on February 1st, 1892, be denounced in time and be not renewed upon expiration. (5) That railway charges be reformed, especially in the matter of through rates (*tarifs de pénétration*). (6) That greater liberty be accorded to those cultivators who make their own wines and spirits (*bouilleurs du cru*). (7) That the French Government undertake new negotiations to end the difficulties which now exist relative to the exportation of French cattle to England.

An important report upon forestry legislation was presented, the conclusions adopted being to the effect that the forestry code should be revised so as to give more efficient protection to private forests, and in consequence the taking of wood or other products should be considered as ordinary theft and punished as such, and

that contraventions in such matters should be dealt with in regular process of criminal law, and not oblige the landowners to bring civil suit.

A report concerning agricultural representation advised that a consulting chamber be formed in each Department, elected by the agricultural societies, clubs, and syndicates, and that a superior council be located at Paris consisting of delegates from such consulting chambers; also that "professional quality" be defined. Finally there was much discussion concerning the taxation of personal estate, and several prizes awarded by the society were distributed.

The general annual assembly of the *Société Nationale d'Encouragement à l'Agriculture*, founded in 1879, was also held at Paris during the first three days of July. Resolutions were passed advocating that wine should be, like other agricultural products, excluded from commercial treaties and submitted to a tax of 20 francs per hectoliter, also restricting the commerce in and wine-making from dried raisins and prohibiting this manufacture at Paris. A prohibitive duty upon foreign silkworm cocoons was also recommended and that new plantations of mulberry trees should be exempt from taxes for ten years.

AGRICULTURAL CLUBS.—COMICES.

The existence of these dates back to the middle of the eighteenth century, the first having been founded at Valandry, in Anjou, in August, 1755. Each year two prizes were awarded, one for the handsomest wheat, the other for the handsomest rye, five inhabitants named by their fellow-townsmen constituting the jury.

The Society of Agriculture of the Generality of Paris, which was the real basis of the present *comices*, was founded in 1761 and had branches at Paris, Meaux, Beauvais, and Sens. Questions of interest were discussed at its meetings, the most efficacious methods for advancing forage culture were sought, and also those for ameliorating the races of domestic animals and for perfecting plows and other instruments. These useful meetings were interrupted by the Revolution.

In 1820 the minister of the interior issued a circular to the prefects of Departments encouraging the formation of such clubs, fully appreciating the benefits which agriculture might derive from their well organized existence. The law of March 20, 1851, which regulates these clubs is in substance as follows: In each arrondissement there shall be established one or more clubs of which each proprietor, farmer, colonist, or his children of over twenty-one years of age may become members, provided his farm be within the limits of the arrondissement, and that he comply with regulations approved by

the prefect. Each such club shall receive aid from the State or Department, to which shall be added the amount derived from membership fees.

These clubs have for their object the furtherance of progress in agriculture in any of its branches in their respective regions. They are regularly constituted, all on the same plan, which has been regulated by government, and the prefect or deputy-prefect of the arrondissement is generally, though not necessarily, honorary president, the mayor of the town or village being at the same time honorary vice-president. The societies receive State subvention and have fixed membership fees varying according to locality from 2 to 20 francs yearly. Meetings are held at least four times a year, while the bureau of the club (president, vice-presidents, treasurer, secretary, librarian, etc.), meets once a month.

Each year the club holds one or more fairs or shows (*concours*), at which prizes are given. In this way it encourages agriculture and may also encourage it in other ways, as by the creation of chemical laboratories or of agronomic stations, the creation of experiment fields, and the institution of courses of lectures; also by giving prizes at primary or normal schools, or to farm servants either for long and faithful services or for care given to animals which take prizes at the above fairs. They may also create special schools for agriculture, viticulture, horticulture, etc., to train farm servants for such, of both sexes. They may also promote the destruction of harmful insects, the preservation of birds, the care of libraries and collections, or the formation of ornamental squares in towns, etc.

Certain of these clubs buy reproductive animals and improved farm tools. The animals are used for the improvement of stock and the tools for prizes at their fairs.

Among these clubs taking part in the Exposition a few may be specially mentioned, such as the *Société Française d'Encouragement de l'Industrie laitière*, the Society at Meaux, and those of Chambéry and of Compiègne, all of which by their exhibits gave evidence of flourishing condition and good work. A remarkable exhibit was made by the *Comité Central de la Sologne* of their work in restoring the prosperity of their district. In the winter of 1879 the cold was so intense that almost all the maritime pines in that district were killed, but under the auspices of the society 700 hectares (1729.7 acres) were replanted between 1879 and 1889. In addition the society had a magnificent exhibit of various woods, pine, oak, poplar, etc., with samples of the various maladies from which the trees suffer.

In 1885 M. Maud'heux, president of the Agricultural Club at Épinal (Vosges), instituted a new and successful plan for the furtherance of interest in rural pursuits. This was the foundation of Military Agricultural Libraries. The plan involves the raising of subscriptions and purchase of useful books upon farming and

kindred subjects, to be placed at the disposal of the garrisons in and around Épinal.

The scheme was received with favor by the Minister of Agriculture and by the military authorities, and was also strongly advocated by the press. By 1888 there was collected a sum of 775 francs, together with 287 volumes and pamphlets which had been donated. These books are said to be eagerly demanded by the soldiers in their leisure moments, more so, perhaps, than books upon other subjects. In fact the enterprise was completely successful, and was deemed by the Société des Agriculteurs de France as worthy of imitation in all the Departments.

It is well known that there is in France the same tendency which has of late years been so marked in our own country, of the rural population to emigrate to the towns. This tendency is considered one fruitful cause of the agricultural crisis. The soldier, when he has finished his term of service and is obliged to seek other occupation, is naturally drawn toward the towns, especially on account of his quality of *ancien soldat*, which gives him preference over others. While in service he has lost interest in agricultural pursuits, and it was in order to restore this interest and to counteract the above tendency that M. Maud'heux developed his scheme.

AGRONOMIC STATIONS AND AGRICULTURAL LABORATORIES.

The exhibits made by these were very important. These stations are instituted by the Departments and receive subsidies from the State. The directors are chosen by competition, and for acceptance they must satisfactorily undergo three sorts of examination: First, they must write two compositions or short essays, one upon some chemical subject applied to agriculture, the other upon some agrological subject of experimental culture or agricultural technology; secondly, they must undergo two chemical examinations upon qualitative and quantitative analysis; thirdly, they are examined in microscopy.

These stations and laboratories are established to inform cultivators concerning the composition of their soils, the nature of their fertilizers, quality of seeds, etc., and the following facts about the work done at some of them may be of interest.

One of the most important of them and one of the oldest is the *Station de l'Est*, founded at Nancy by M. Louis Grandeau, who also showed at the Exposition the results obtained at the experimental farm at Tomblaine, near Nancy, with various manures, phosphates of lime, nitrates of soda, etc., upon wheats and tobacco.

M. Gayon, professor of chemistry at Bordeaux and director of the agronomic station in that city, has more particularly devoted himself to the study of wines and of viticulture. It is he who, with his colleague, M. Millardet, has formulated the proportions to be adopted

for the Bordelaise mixture, so efficacious against grape mildew. He has also, by aid of instruments exhibited by him, analysed the wines of the Gironde, and has also studied the diffusion and insecticide power of bisulphide of carbon.

M. Colomb-Pradel, director of the station of Loir-et-Cher, is occupied upon the coloring matter of the wines of the country and the methods used to fraudulently imitate these. He made an exhibit of this work, together with numerous samples of marls, with their analyses.

At the station of Châteauroux the greater part of the soils of the Département de l'Indre have been analysed, while at that of the Cher an agronomic map of the Department has been made.

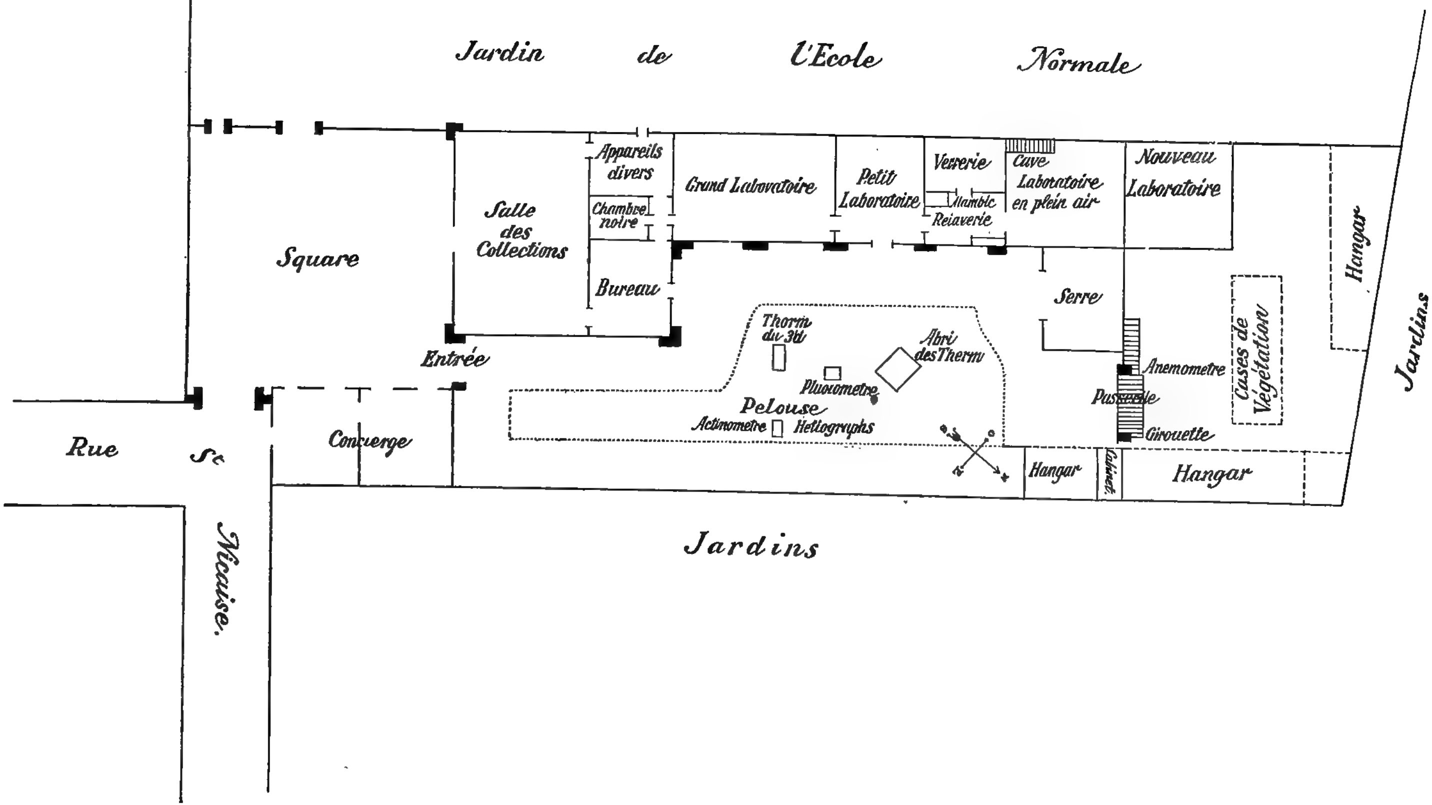
M. Hougeau, director of the station of Seine Inférieure, has invented an apparatus by means of which he estimates the total nitrogen in substances which contain nitrogen in three forms at once, organic, ammoniacal, and nitric. His "gravi-volumeter" is extremely ingenious, and by its use burettes are rendered needless. It gives at a determined temperature for any one liquid (saline solution or fixed acid) drops of constant weight. With his "azotimetric battery" four determinations of nitrogen may be made simultaneously in four minutes.

The experiments tried at the station at Chapelle (Nord) by MM. Violette and Desprez upon wheat and sugar-beet culture are well known. Handsome specimens of their work were exhibited, showing that these experiments have been entirely successful. These scientists have recognized the fact that varieties of the beet, early, rich, and well adapted for sugar-making can be obtained by proper methods. If early varieties give less weight than those which mature later they have the advantage over the latter of being available at the commencement of the sugar season, which is a great saving to the cultivator.

Agriculture is but little advanced in the center of France; therefore M. Parmentier, director of the station at Clermont-Ferrand, showed in a fine collection of cereals the difference between the wheat of the country as cultivated by old methods and as cultivated with appropriate fertilizers.

Also noticeable is the fact that agronomic stations have acquired such importance that the station of Seine-et-Marne alone made 11,322 analyses of all sorts from July, 1877, to January, 1889.

Finally, the very beautiful collection of marine fauna from Pas-de-Calais and the neighboring regions, shown in this same class in the exhibit of the agricultural station at Boulogne-sur-Mer, together with the lithology of corresponding sea bottoms, was well worthy of notice. There are in France a number of maritime laboratories, among which may be mentioned those at Roscoff and Concarneau in Brittany, at Banyuls and at Marseilles. These are included under the jurisdiction of the ministry of agriculture.



PLAN OF AGRONOMIC STATION OF THE DEPARTMENT OF PAS-DE-CALAIS AT ARRAS.

In order to give a more complete idea of agronomic stations, one or two of their number may be described more in detail.

The agronomic station of Pas-de-Calais, created in 1869, was at first annexed to the college at Arras, but since 1883 it has been established in the same town in a building especially constructed for its use, which, with its equipment, cost 40,000 francs ($8,000). A ground plan of the laboratory is here shown. (Plate v.)

The personnel consists of one director, M. Pagnoul, two assistant chemists, and one laboratory servant, and the budget is made up as follows:

	Francs.
Salary of the director	6,000
Salary of the first assistant chemist	2,000
Salary of the second assistant chemist	1,800
Salary of the servant	1,000
Laboratory expenses, printing, etc	4,000
Total	14,800

The station is subsidized to the amount of 2,500 francs, and the fees received from analyses, etc., are all paid into the treasury of the Department, and amount annually to about 3,500 francs, so that the whole annual expense to the Department is only about 8,800 francs.

The station is open to the public for the analysis of agricultural samples of all descriptions, moderate fees being charged for this service, a tariff of which is published by the director, together with directions for taking and sending samples. A few of these charges are appended:

	Francs.
In fertilizers, nitrogen, of either category	5
In fertilizers, potash	5
In fertilizers, total phosphoric acid	4
In arable soils, nitrogen	5
In arable soils, phosphoric acid	6
In arable soils, potash	8
In arable soils, lime	5
Sugar beet (density, richness, etc., of juice)	4
Absorbent power of bone black	4
Forage (water, nitrogenous matter, etc.)	7
Milk (density, sugar, fatty matter, ash, etc.)	10
Wine or beer (percentage of alcohol)	4

Under certain conditions samples of soil are examined gratis. In 1887 there were made at the station 608 analyses and in 1888 there were 572. The greater part of these came from the Department itself and the neighboring regions, though there were several samples coming from distant parts of France.

The study of the various deposits of phosphates in the Department forms an important part of the work of this station and an exhibition of them was made, together with a map of the region showing their localities. Large quantities of coprolite are mined there annually, made into fertilizers and sent in all directions.

The most important work of the station, however, is in connection with the sugar-beet industry, the Department of the Pas-de-Calais being one of the principal where this crop is grown and where beet sugar is manufactured. Several years ago there were 100 sugar factories there, which number had fallen to 74 in 1884 and to 62 in 1885. Notwithstanding this, the Department produced over 600,000,000 kilos of beets in 1885, this being the product from 22,000 hectares, and having a valuation of 12,000,000 to 13,000,000 francs. Therefore the station is particularly occupied with investigations of all sorts concerning this important crop, such as testing the germinative power of the seed, the analysis of the roots themselves, and experiments upon cultivation and appropriate fertilizers.

The station publishes a yearly report of its work and also a daily weather report with forecasts for 24 hours and a monthly weather report with indications upon the state of the crops. It also issues extra publications from time to time, such as an explanation of its manner of testing the germinative power of beet seed, the method of analyzing soils, together with a series of soil analyses from the neighboring region, etc.

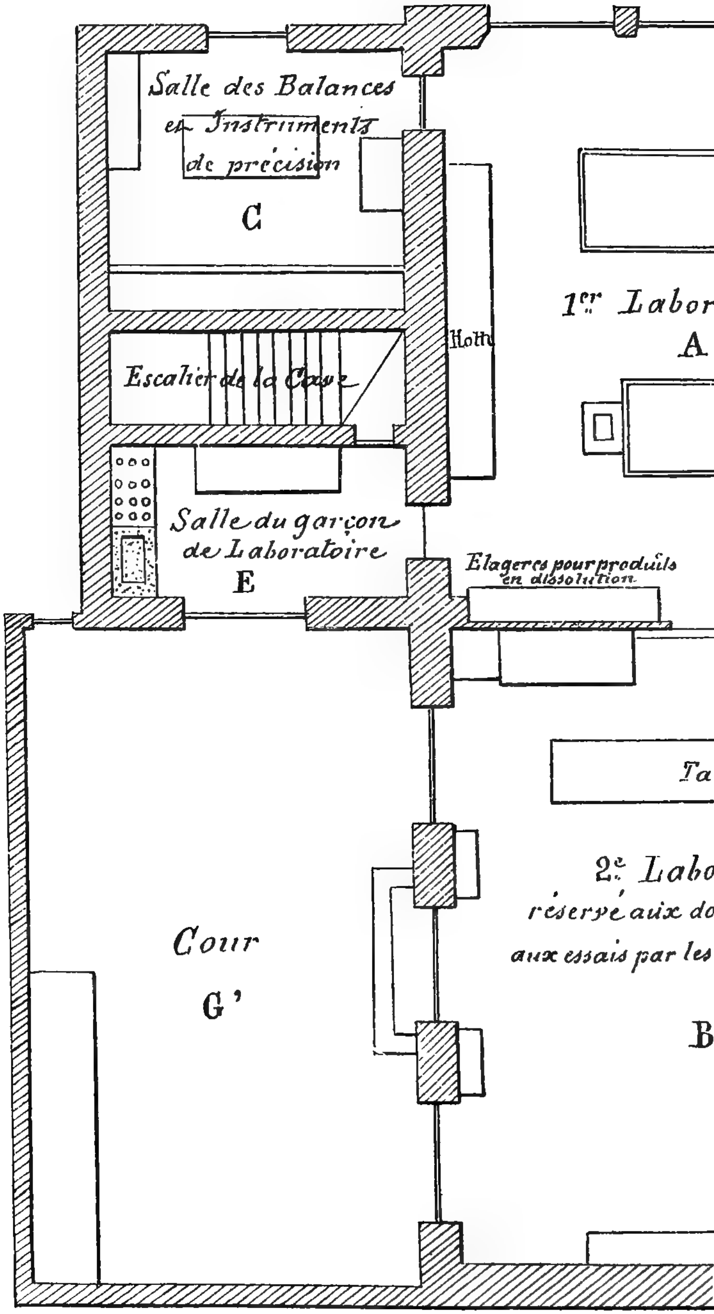
The agronomic laboratory of the Department of Seine-et-Oise was opened July 1, 1885. Its objects, as stated, are to further agricultural progress in its region, but especially to repress fraud committed in the commerce of fertilizers. This station is situated at Versailles, and is directed by M. Rivière, a well-known chemist.

The total number of analyses performed at this station in four years (July 1, 1885, to June 30, 1889) was 2,505, comprising no less than 9,646 separate determinations. All these were of samples brought to the station and exclusive of scientific researches. A similar tariff of charges exists here as at Pas-de-Calais.

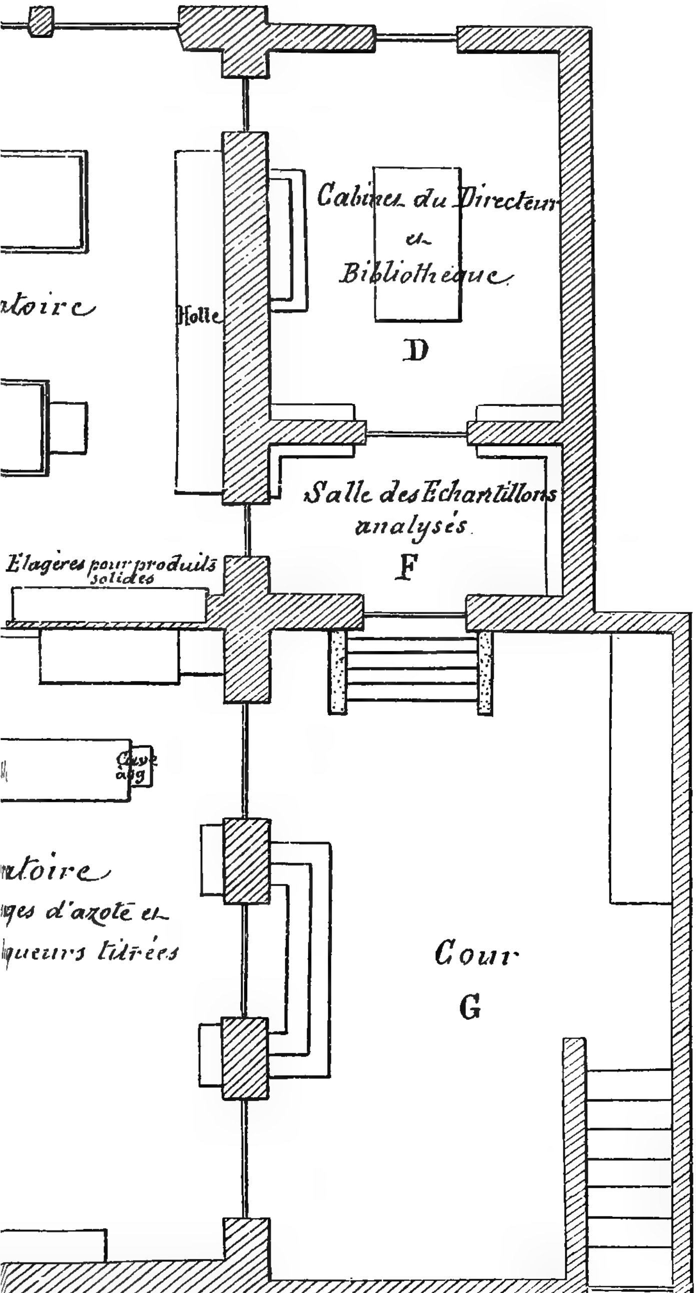
At this station also a series of experiments have been made upon the influence of nitrogen and phosphoric acid upon various crops, and particularly upon the potato and the sugar beet.

The station has also supervised a series of field demonstrations carried on in 1886 by the *comice* of the Department of Seine-et-Oise. An account of some of these may be of interest:

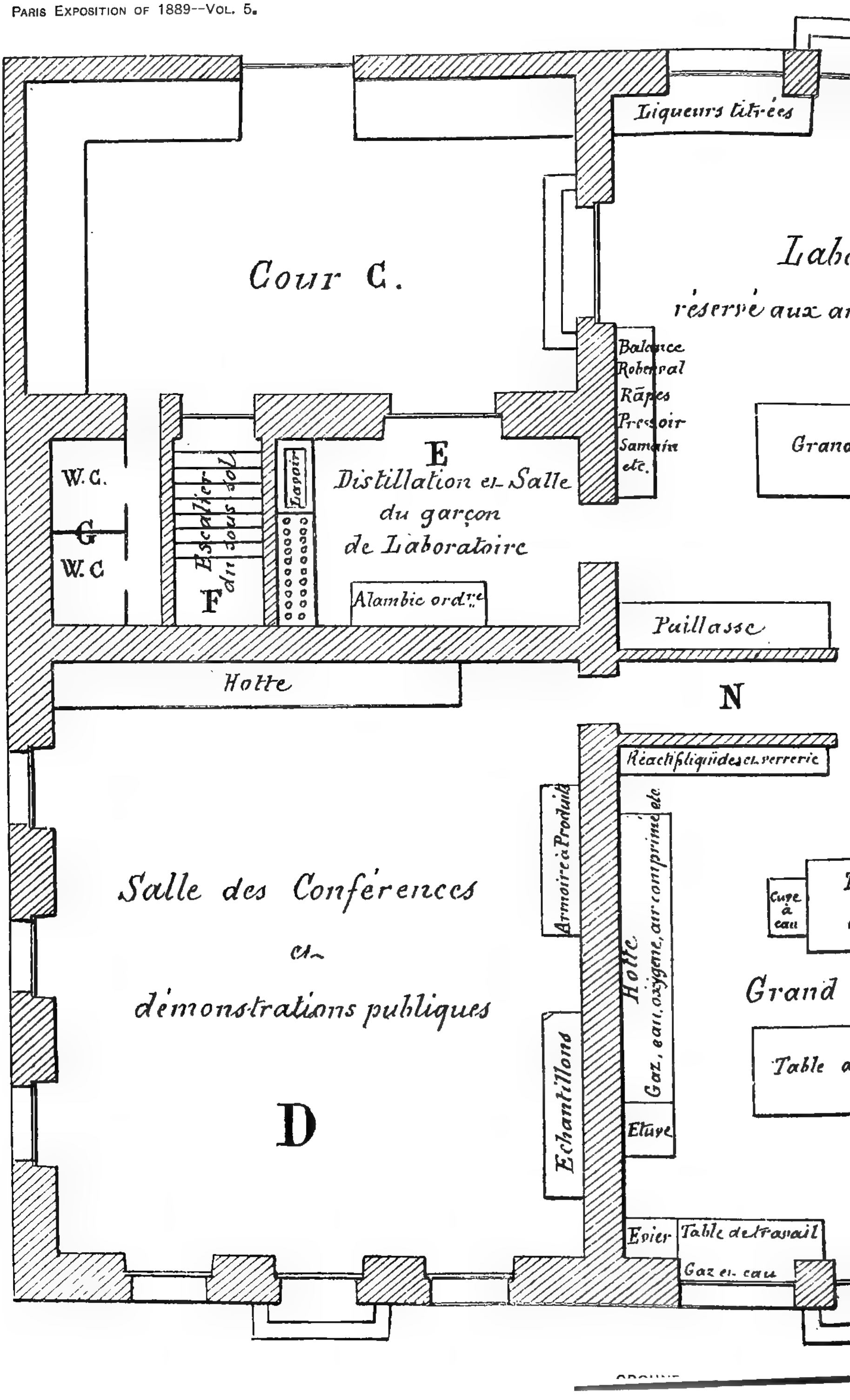
(1) At Carrières-St. Denis, on the banks of the Seine, a field of 60 ares (1.68 acres) had been sown in the autumn of 1885 with Saumur wheat. In the spring of 1886 just one-half of the field was strewn with a mixture of 60 kilos of nitrate of soda and 120 kilos of superphosphate of lime, corresponding to 200 kilos of the former and 400 of the latter per hectare (the superphosphate contained 14 per cent of phosphoric acid). At harvest time it was found that the half of the field thus strewn yielded in the proportion of 39 hectoliters of grain and 5,000 kilos of straw to the hectare; whereas the yield upon the half not thus treated was in the proportion of 26 hectoliters of grain and 4,300 kilos of straw, *i. e.*, the yield of grain had



GROUND PLAN OF AGRONOMIC STAT



T MELUN (SEINE-ET-MARNE).


Liqueurs titrées
Cour C.
Balance
Roberval
Râpes
Pressoir
Samain
etc.
E
Distillation et Salle
du garçon
de Laboratoire
W.C.
G
W.C
Escalier du sous sol
F
Lavoir
Alambic ordre
Paillasse
Hotte
N
Réactifs liquides et verrerie
Armoire à Produits
Salle des Conférences
et
démonstrations publiques
Echantillons
Hotte
Gaz, eau, oxygène, air comprimé etc.
Cuve à eau
Grand
Table
Etuve
D
Evier
Table de travail
Gaz et eau

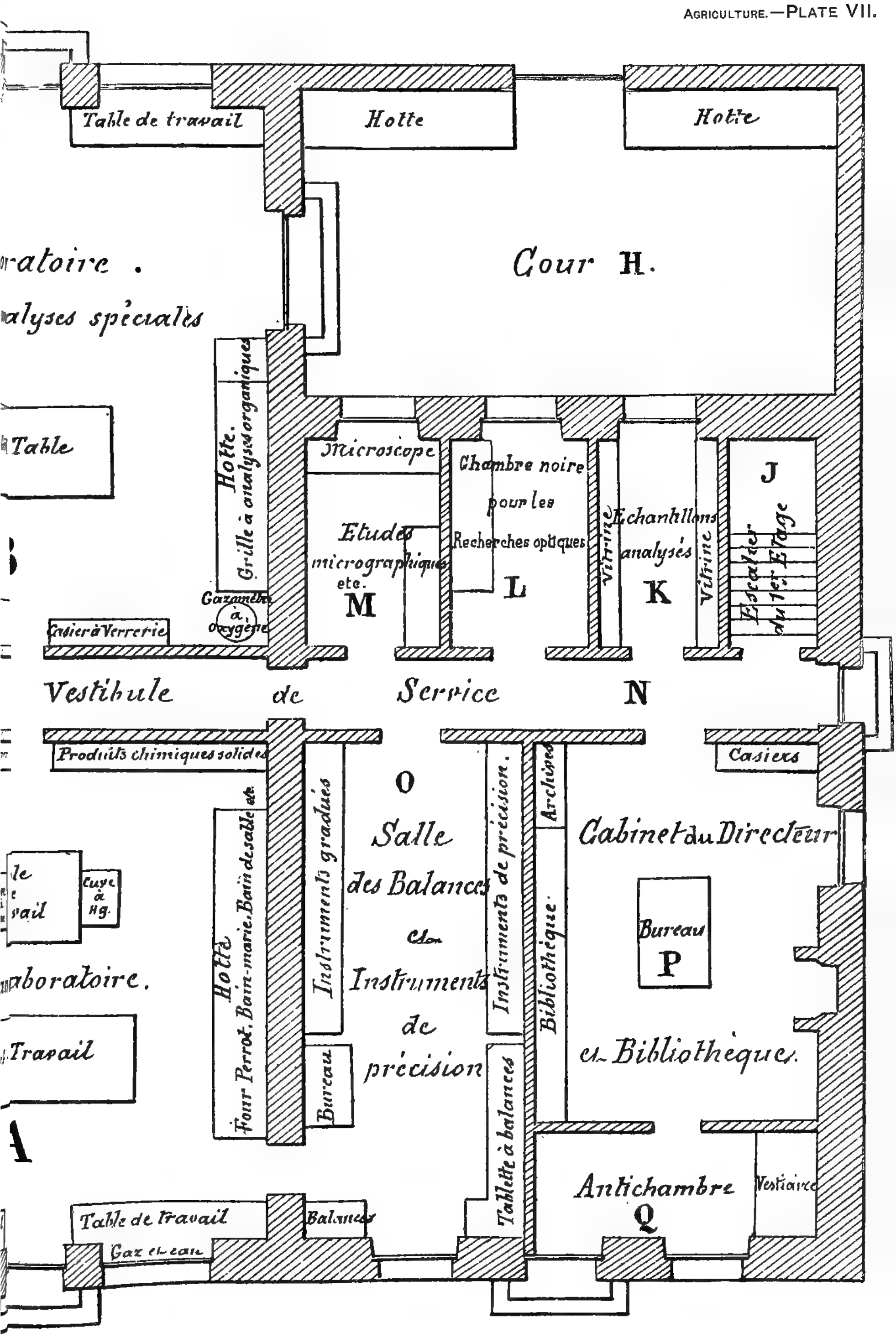


Table de travail
Hotte
Hotte
Cour H.
ratoire.
alyses spéciales
Hotte. Grille à analyses organiques
Table
Microscope
Chambre noire pour les Recherches optiques
Vitrine
Echantillons analysés
Vitrine
J
Escalier du 1er Etage
Etudes micrographiques etc.
M
L
K
Gazomètre à oxygène
Casier à Verrerie
Vestibule de Service
N
Produits chimiques solides
Casiers
O
Salle des Balances et Instruments de précision
Instruments gradués
Instruments de précision.
Archives
Bibliothèque
Cabinet du Directeur
Bureau
P
et Bibliothèque.
Hotte Four Perrot, Bain-marie, Bain de sable etc.
Cuve à Hg.
aboratoire.
Travail
Bureau
Tablette à balances
Antichambre
Q
Vestiaire
Table de travail
Balances
Gaz et eau

increased 50 per cent and that of straw over 16 per cent, the application of such fertilizers having at an outlay of 95 francs per hectare increased the total yield by 240 francs, or having added 145 francs net value to the crop from one hectare.

(2) In a similar way, by the use of 400 kilos of nitrate of soda immediately after planting a hectare of land was made to yield 75,000 kilos of forage beets (*ovoïde-des-Barres*) whereas a hectare alongside, not so treated, only yielded 54,000 kilos. This corresponded to an increase of 39 per cent, while the value of the increase was 315 francs, the expense of fertilizer being only 118 francs, or, in other words, the increase in value was nearly 200 francs per hectare.

(3) In the same way the yield of black Étampes oats was increased from 2,250 kilos (or 45 hectoliters) of grain and 3,950 kilos of straw, to 3,060 kilos (or 60 hectoliters) of grain and 4,900 kilos of straw per hectare, or an increase of 810 kilos of grain and 1,050 of straw for an outlay of 85 francs.

(4) A field of white forage carrots, being treated with 400 kilos each of nitrate and superphosphate, yielded 75,000 instead of 50,000 kilos of roots, or an increase of 50 per cent.

Such experiment fields are common at all the Agronomic stations and are generally not the property of the station but of private cultivators who volunteer to furnish them according to the following conditions: The farmer loans from 30 to 60 acres of land for a term, generally from 3 to 6 years, and furnishes without cost all the barnyard manure and native wheat or other seed which may be required. He also furnishes the labor of his farm hands and horses, and the use of his instruments, etc., and agrees to scrupulously obey the directions given by the directors of the experiment station, and observe the exact weight of all manures and seeds used. In return he receives the whole crop from the experiment field, save such amounts as are required for samples for analysis or collections. The State or Department pays for all *choice* seeds and for all chemical fertilizers used other than farmyard manure, as well as all extra expenses. These experiment fields, as well as similar ones for demonstration, are always open to the public, and all necessary information is liberally given at the experiment station. Care is taken to locate them as near as possible to villages and railway stations, and as often as possible upon public highways, and an accurate account is kept of all data and particulars concerning them.

Plans of the laboratories of the Agronomic stations at Melun (Seine-et-Marne) (Plate VI) and at Dijon (Côte d'Or) (Plate VII) are here given. The former station, founded in 1875, has a fine collection of apparatus and a small experiment field of its own. It is principally engaged in general analytical work, but also makes researches upon vegetable physiology and fertilizers.

REGIONAL FAIRS—HONORS AND SPECIAL PRIZES.

(1) *Butcher's Fairs.*—The first of these fairs was instituted at Poissy in 1844 in order "to increase the number of animals fit for slaughter, and to favor the propagation of races which by their precocity would furnish the most meat for consumption, and also to encourage the improvement of such farms as were recognized as being best for the production of meat from races native to France." Since 1850, the date of the institution of fat cattle fairs at Bordeaux, Lyons, Lille, and Nantes, the Poissy fair has been transformed into a general exhibition, and since 1868 has been held annually at Paris in February, in the Palais de l'Industrie. To it has been added an exhibition of animals for breeding purposes, of poultry (live and dead), of butter and cheese, and of various farm products. The expenses of these fairs have been:

	1886.	1887.
	Francs.	*Francs.*
Commissariat	2,400	2,400
Installation and divers expenses	95,500	122,200
Value of objects of art for prizes	16,811	14,500
Value of money prizes	95,885	85,700
Value of medals	9,753	7,813

(2) *Regional Fairs.*—The fairs instituted with a view to encourage the amelioration of breeding-animals (bovine, ovine, and porcine), and of the best poultry, the use of instruments and agricultural machinery date back to 1849, when they were held in connection with the Agronomic Institute at Versailles. In 1851 three regional fairs were organized, and also one general fair. The success of these having exceeded all expectation the number of regional fairs was increased each year. Up to 1850 France was divided into ten of these regions; in that year the number was increased to twelve; in 1886 it was reduced to six, and was finally fixed at eight in 1888.

At each fair, in accordance with a fixed custom, several objects of art are awarded to the best group of animals, consisting of one male and three females of the same race, all raised by the exhibitor. A sum of money and several silver and bronze medals are distributed among those who have had the care of prize animals.

Special competitions for agricultural instruments and machines are organized, either to be held at the same times with the above fairs or separately at convenient periods, according to the uses to which the machines are put, etc., and prizes in money or in medals are given. A sum of money, with medals, is also distributed among the workmen and foremen of exhibitors who have taken prizes. The expenses of material, installation, etc., are borne by the governments of the towns where such competitions are held, while the rev-

enue from admission fees is exclusively reserved for the town treasury, as also is the sum derived from the sale of catalogues or prize lists.

These regional fairs have had great influence upon the progress of French agriculture. The expenses of some of them have been as follows:

	Twelve fairs in 1886.	Six fairs in 1887.
	Francs.	*Francs.*
Prizes in money	337,000	406,900
Value of objects of art	28,600	24,500
Value of medals	106,000	97,128
Commissariat	2,400	2,400

(3) *Prizes of Honor and special Prizes.*—The prize of honor was founded in 1856, in order to recompense the agriculturists in the department in which the best regional fair was held. In 1869, in order to encourage all efforts which had any tendency toward general progress in agriculture, several categories of prizes of honor were created. Since then, in 1885, special prizes have been instituted, such as prizes for irrigation, recompenses for small cultivation, for horticulture, for rural journals, etc.

FOREIGN COUNTRIES.

AUSTRIA AND HUNGARY.*

Specially organized agronomic stations do not exist in Hungary, but researches and analyses are made at the agricultural institutes by special professors in laboratories placed at their disposal. These laboratories are well equipped and there is a sufficiency of experiment fields and stables. It is thought advantageous not to separate agronomic stations from such institutes where there is already a well-instructed personnel, good libraries, and many other resources. There are six principal localities where agronomic researches are carried on: The veterinary school at Pesth, the academy at Magyar-Ovar, and the institutes at Keszthely, Debreczin, Kolosz-Monostor and Kassa.

Seed-testing Stations.—There are six of these at the above-mentioned institutions; they are all organized upon one plan and are independent of the institutions at which they are located. They have surveillance over commerce in grain and seeds and in other important farm and garden products. They protect the cultivator from fraud and aid him in the selection of the best seed; they test the purity and germinative power of seeds and the brewing quality

* For the statement from these countries I am greatly indebted to a paper read before the Agricultural Congress at Paris, 1889, by I. Maday.

of barleys and they examine for *Cuscuta* and other injurious parasites, a small fee being demanded for all services. In certain cases, however, examinations are made without charge. The most important of these stations is that at Buda-Pesth, where 354 samples of wheat were examined in 1885, 850 in 1886, 1,138 in 1887, and 1,379 in 1888.

Stations for Trials of Machines.—There is but a single station of this sort in Hungary, and it is at the academy of Magyar-Ovar. Its object is to examine new agricultural machines as to their utility and mode of working and to publish the results of these investigations. Special examinations are also made at the request of the Government or of agricultural societies. Among the machines tested in 1888 were the Bradley cultivator, Schneider's potato-planter, the Berolina line-sower, various hydraulic rams, Halladay's wind-mill motor, etc. The station has also tried experiments upon the loss of grain in steam thrashing machines and has published divers articles upon these subjects in Hungarian or foreign journals.

Sericiculture.—In Hungary this industry is in the hands of the Government and there are no sericicultural stations which make researches for the general public, but the Government possesses at Szegszard a station where microscopic examinations for pébrine and experiments in silk-culture are carried on.

Viticulture.—There is no special viticultural station, researches in all matters pertaining to grape-culture being performed at the institutions already mentioned, which also make investigations in wine-making and in vegetable pathology.

In 1881 a station for researches upon the Grape Phylloxera was established in Hungary. At first only the Phylloxera was studied, but later on attention was also given to other insects and parasites injurious to cultivated crops. This station is directed by an entomologist with one assistant and has seventy-one correspondents in various countries. The total expense of the station is 9,500 florins ($4,750) annually.

Experiment Fields.—These are attached to each of the agronomic institutes and to all the primary agricultural schools, as well as the Phylloxera stations. Each of these institutions prepares an annual programme of experiments to be carried out, and executes it, a report being published in the yearly annals and by the ministry of agriculture.

The academy of Magyar-Ovar and the four institutes are also stations for the examination of fertilizers and for the analysis of soils, to which the public has access. In addition there is at Buda-Pesth a special station for agricultural examinations of all sorts, and there are chemical stations at Presburg and at Kolozvar. These stations perform analyses for farmers according to moderate fixed tariffs, and also afford them counsel as to the management of their crops. They

analyze Hungarian wines, combat fraud, and disseminate useful knowledge. In 1888 the chemical station at Buda-Pesth made 2,099 analyses.

The control of fertilizers and their commerce is not yet organized by legislation, but is practically in the hands of the cultivators through the instrumentality of the National Agricultural Society and the above chemical stations.

BELGIUM.

In 1885, by a decree by the minister of agriculture, experiment fields were instituted. These were placed under the direction of scientists employed by the State and under the patronage of the agricultural clubs, their plan and objects being regulated by the minister. An arrangement similar to that made in France is made between the state and the owner of the land upon which the field is situated. At first it was determined to have five such fields in each province, or fifty in all, but the farmers were so willing to offer their land that eighty-three were obtained during the first year.

LUXEMBURG.

Agricultural service in this country was regulated by law in 1883, and an agricultural engineer, with a superintendent and aid, were placed in charge; but in 1888, this force having been found insufficient, it was increased so that it now consists of one agricultural engineer, who is chief of service; one superintendent, with one deputy; one deputy chief of office: thirteen temporary technical employés, and four clerks.

The service has charge over everything concerning agriculture, its special departments being as follows: (1) Works of irrigation and sanitary improvement; (2) drainage; (3) care of unnavigable rivers; (4) construction of roads; (5) general improvements in agriculture; (6) enforcement of laws concerning the police of dwelling houses as far as regards the construction of cesspools; (7) plantations of fruit trees; (8) reports upon all agricultural matters.

The superficial area of the Grand Duchy of Luxemburg is 258,745 hectares (639,359 acres), of which over half is cultivated or used as pasture. There are 67,693 landowners, most of whom have holdings of from 10 to 20 hectares or even less, while only 720 hold more than 50 hectares each. In the greater part of the country the land is divided into very small lots, the average size of these being only 0.26 hectare (or 0.64 acre), and many of these lots stand in isolated positions difficult of approach.

A law was passed in December, 1883, to encourage the formation of syndicates for the carrying on of improvements such as irrigation, drainage, road building, and works of general agricultural utility.

Ordinary operations, such as the cleansing and improvement of water-courses are performed at the expense of those most benefited thereby, but in the case of more important operations half the expense is borne by the State.

Much of the meadow surface of the country is in need of improvement, having been either destroyed by drought or choked by stagnant water. The necessary work of irrigation or drainage is appreciated by the farmers, who themselves often take the initiative, the State agricultural service furnishing them necessary advice and the gratuitous aid of an expert. The average cost of such improvement is 250 francs per hectare, which is of course paid by the landowner. Since 1880 there have been 2,279 hectares thus irrigated and 225 hectares drained, the total cost having been 629,835 francs, of which 120,000 francs were furnished by subsidy.

The agricultural service is also especially called to direct the labors of regulating and cleansing (*curage*) water courses already existing. These labors are performed according to fixed plans submitted to the riparian owners, who are formed into syndicates. The expense for a stream 8 meters (26¼ feet) wide is 2,000 to 3,000 francs per kilometer, which is paid by those benefited in proportion to their interests, the State, however, often assuming half the expense or giving subsidies. Since 1880 there have been performed 485,949 meters of such work, at a cost of 1,160,084 francs, with subsidies to the amount of 364,850 francs.

Cesspools or cisterns for liquid manure are very generally constructed in Luxemburg and are utilized for the benefit of agriculture as well as for sanitary purposes. From 1881 to 1888 there were constructed 2,469 such cisterns, subsidies having been granted to the amount of 80,423 francs. To small cultivators having only one or two head of cattle the Government makes gratuitous distribution of portable cisterns of 500 to 600 liters capacity.

Fruit Trees.—The rigorous winter of 1879–'80 having destroyed the fruit trees and having occasioned thus a loss of about 6,800,000 francs, the State has offered annual subsidies for the encouragement of the planting of new trees. Since 1883 the number of trees planted was 180,452, and the subsidies accorded amounted to 71,000 francs.

The extreme division of soil (*morcellement*) in the Grand Duchy has necessitated the frequent building of roads or lanes to reach isolated fields. The State, therefore, in 1889 allowed a special subsidy of 30,000 francs for this purpose.

There are two large agricultural societies in the Grand Duchy, besides an agricultural school and station at Ettelbrück, founded in 1884. There are also local agronomic associations, the first of which was founded in 1875. These are formed by the farmers of the villages, who meet for mutual improvement and information in rural matters and to acquire and use in common new and improved instru-

ments, to procure good fertilizers and seeds, etc. Several of these societies possess libraries, and they are all directed by intelligent men and receive government subsidies.

RUSSIA.

Prof. Dokoutchaïeff, of the University of St. Petersburg, together with his pupils, exhibited a collection of one hundred and nine samples of soil coming from all parts of the empire and representing 99 per cent of the total arable soil. All these samples were collected by the Professor himself, according to a fixed plan, and consisted exclusively of vegetable soils, mostly argillo-silicious, formed upon the steppes or the northern prairies, or in the forests. The collection was accompanied by charts and descriptive tables and also by copies of works upon Russian soils.

SERVIA.

The Agricultural Society of Belgrade was founded in 1870. It publishes a journal, a calendar, and various works upon different branches of agriculture, and also serves as intermediary for the purchase of the best seed, or of instruments or machines. It has branches throughout the country.

The Prince Michael Society was founded in 1888 for the improvement of the breeds of horses. The state possesses a domain at Topchidère for the cultivation and transplanting of the best qualities of fruit trees and also for improving the breeds of cattle and sheep. There are also two State horse-breeding stations at which there are also nurseries for fruits trees; and there are also several stations primarily engaged in the introduction and study of American vines which resist the Phylloxera.

JAPAN.

The agricultural and forestry school at Tokio (formerly at Komaba) exhibited tables of its analyses of various soils, products, etc., making an exhibition similar to that which it made at Sydney in 1879 and at New Orleans in 1884.

VICTORIA, AUSTRALIA.

An experimental farm of about 4,800 acres has been established at Dookie, having been completed in 1878. In 1888 there were sown upon this farm 280 acres of wheat, together with lesser quantities of barley, oats, maize for ensilage, lucern, grasses and root crops, all for experimental purposes. The wheat comprised forty different varieties. Experiments were also made upon the prevention of smut. About 4 acres are planted with olive trees and yield about 100 gallons of oil yearly. In 1887 there were 1,616 gallons of wine yielded by

5 acres. Experiments are also tried with flax, hemp, sugar beet, maize, mangolds, sorghum, millet, chicory, and medicinal plants. The estimated value of live stock, implements, buildings, and produce upon this farm in 1887 was about £6,780 ($33,900).

BRAZIL.

The agricultural institute at Rio Janeiro was founded by Dom Pedro II, in November, 1860. Its object is to aid in the development of agriculture in several ways, as follows: (1) by facilitating the use of instruments and machines instead of manual labor; (2) by seeking the best system of colonization, either national or foreign; (3) by establishing stations for the trial of machines, or for the testing of systems of cultivation, methods of manufacture, improvement and preservation of products, and processes for the destruction of injurious insects, etc.; (4) by procuring the best seeds, plants, etc., and distributing them to cultivators; (5) by studying the improvement of live stock and the introduction of the best races; (6) by aiding the Government in perfecting means of transportation; (7) by organizing an annual exhibition of farm products; (8) by publishing a yearly statement of the agricultural statistics of the country, with a view to exhibiting the status of agriculture, and the permanent or temporary causes affecting the same; (9) by publishing a review intended to popularize good principles of rural economy; (10) by creating agricultural schools or by supporting professors of agriculture who should teach in other schools or in private institutions.

This institute is managed by a board of nine directors and a council of twenty-eight. In each large town there are commissions which study the agricultural needs of their districts, and organize the statistical service, reporting to the institute. The patrimony of the institute amounts to 349 *contos*, or over $200,000. Its publication, the Revista Agricola, is issued quarterly.

The institute has also established an agricultural asylum and a normal farm, all at Rio Janeiro, and directs a botanical garden subsidized by the state. The asylum was opened in 1868. (See Class 73 *ter*.) The normal farm contains about 10 acres, and makes experimental culture of such plants as are commonest among the farmers—sugar cane, cotton, tobacco, manioc, arrowroot, coffee, cocoa, vanilla, etc. Experiments are also made as to the acclimatization of ramie, jute, sorghum, the mulberry, tea, etc. The latest machinery is also tried and used.

The agricultural institute at Bahia was founded in November, 1859, and is similar to that at Rio. It has a patrimony of 96 *contos*, or about $55,000, and has also created a school at San Bento de Lages.

The agricultural institute at Sergipe was founded in January, 1860, upon the same basis as that at Bahia. It has attempted, though unsuccessfully, to found a model farm school.

The agronomic station at Campinas was founded in October, 1887, in the province of San Paulo, in the center of an important agricultural district. A German agriculturist, Dr. Dafert, of Bonn, was called to take charge of the station. The apparatus used at the station is also of German manufacture. Besides the director, the personnel consists of a secretary, two assistants, and a corps of laborers. Four distinct divisions of work are made: First, there is an analytical laboratory for the use of planters or dealers; secondly, a laboratory for the trial of fertilizers and the cultivation of new plants, as well as for improvement in staple crops; then there is a meteorological bureau, which is in correspondence with the meteorological institute at Hamburg; finally, there is an œnological bureau under the direction of an Australian specialist.

There are many other agricultural organizations in Brazil, among which may be mentioned the societies of Pernambuco and of Rio Janeiro. The latter dates back to 1820, and has always been of signal service to the agriculture of the country. It publishes a review, to which the State accords an annual subsidy of 6 *contos* ($3,400).

CHILE.

There is a national society of agriculture at Santiago, annually subsidized by the State in prizes given at agricultural shows, and for the cultivation of trees in public avenues and promenades, and also for the maintenance of a zoölogical garden.

URUGUAY.

A rural association has existed at Montevideo since 1871. This association is devoted to rural interests and to the dissemination of knowledge in all branches of agriculture, and has already rendered great services.

CHAPTER III.

CLASS 73 TER.—ORGANIZATION, METHODS, AND APPLIANCES OF AGRICULTURAL INSTRUCTION.

By C. V. RILEY

Plans, models, and programmes of the agricultural primary schools, agricultural orphan asylums, farming schools, or apprentices' schools.
Methods and apparatus of instruction, fields for experimenting, etc.
Work done by pupils.
Plans and models of practical agricultural schools, of special schools of vine culture, horticulture, and forestry, etc.
Methods and apparatus of instruction.
Work done by masters; specimens of work done by pupils.
Plans and models of national schools of agriculture, of agricultural academies. Veterinary schools. Schools of forestry. Agricultural high schools; agronomical institutes.
Methods and apparatus of instruction.
Work of professors, specimens of pupils' work.

PART I.—FRANCE.

THE MINISTRY OF AGRICULTURE.

"Of all branches of human industry," says the eminent and popular director of agriculture of France, M. Tisserand, in his report to the agricultural congress of 1889, "agriculture is assuredly that which occupies the greatest number of men, which comprises the most interests, and the progress of which counts for most in the development of the wealth of nations." And it would certainly seem that the French people bore these facts in mind, for probably in no other country in the world has agriculture received greater attention from the Government, or have the people—taking advantage of an extremely fertile soil and of a climate adapted to very diversified branches of cultivation—striven more to improve their agriculture by means of the application of science, by mutual counsel from societies or syndicates, and by a very complete system of agricultural instruction placed under the immediate supervision of the Government.

At this Exposition, agricultural instruction was for the first time made the object of a special classification, and the whole of one of the galleries upon the Quai d'Orsay was allotted to it. The ministry

of agriculture set the example by exhibiting statistical charts and various objects, illustrative of its organization, and including samples of the prizes awarded at regional fairs and other competitions. The new decoration of the *Mérite Agricole,* instituted in 1883, was displayed and was held up to all sincere agriculturists as a goal to be striven for, only inferior to the historic Legion of Honor. All the principal agronomic schools sent full and interesting exhibits of the work done by their professors and pupils, the whole making a most instructive display.

Previous to 1789, 50 per cent of the total population of France was engaged in agricultural pursuits. At the present day there are in the country 6,913,500 cultivators, who, with their families and employés, form a population of about 18,250,000 persons living upon husbandry alone, or about 47 per cent of the present population.* There are at present 5,670,000 holdings in France of which 2,167,600 occupy less than 1 hectare, 2,635,030 occupy from 1 to 10 hectares, 629,394 occupy from 10 to 30 hectares, 240,000 occupy from 30 to 100 hectares, 30,000 occupy over 100 hectares.

The capital employed in agriculture exceeds 100 milliards (or 100,000 million) of francs. The animals used are valued at 5,775,000,000 francs, the seeds at 50,000,000, and the material at 1,395,000,000, a total of 7,220,000,000 francs. The crude products are worth 14 milliards and the wages paid exceed 4 milliards annually.

At the head of this enormous interest, regulating it by just laws, guiding it by wise counsel based upon scientific discoveries and teachings, providing it with instruction and protecting it under the Government, is the ministry of agriculture, completely organized and composed of some of the foremost scientists of the world.

Before its elevation to the dignity of a separate ministry, the agricultural service of France was, from 1828 to 1881, successively attached to various other ministries, notably to those of commerce, and the interior or public works; but by a decree of November 14, 1881, signed by President Grevy and M. Gambetta, it was made an independent ministry, and has since remained so.

The minister of agriculture is aided in his duties by four directors, each presiding over a special directorship, and also by a superior council drawn from these directorships, and convened whenever its advice is requested by the Chamber of Deputies.

Of the four directorships that of agriculture is the most important; it is presided over by the director of agriculture, who holds the next rank to the minister, and it is divided into three bureaus: (1) Agricultural instruction and encouragement; (2) veterinary schools and service; (3) legislation, finance, and Phylloxera. In addition to these there is the statistical service.

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*On May 30, 1886, the total population of France was 38,218,903.

The second directorship is that of forests, and consists of the following bureaus: (1) Litigation, forestry instruction, acquisitions; (2) wood-cutting and other revenues; (3) clearing, reforestation, etc.

The third directorship, that of stud (Haras), is divided into two bureaus: (1) Administration of establishments, and replacing of horses, (2) encouragement of equine industry.

The fourth directorship is that of waterworks, and comprises two bureaus: (1) Police and care of watercourses; (2) the budget, canals for irrigation and submersion, locks, inspection, etc.

There are also various councils, committees, and commissions for the consideration of technical affairs, as follows: Superior commission upon Phylloxera; consulting committee upon epizoötic diseases; council for perfecting veterinary schools; consulting committee upon agricultural stations and laboratories; council of administration of forests; consulting commission for agricultural water works, and superior stud council.

Upon the directorship of agriculture depend three important exterior branches of service: The inspection of agricultural instruction, that of agriculture proper, and that in connection with the Phylloxera.

The inspection of agricultural instruction was created in December, 1883, and is composed of one inspector-general, at a fixed salary of from 6,000 to 10,000 francs, with 5,000 francs allowance for expenses; two inspectors, with salary of 5,000 francs each and an allowance of 3,000 francs each for expenses. These three officers divide France between them, following certain railway lines, viz: (1) Along the lines of the Chemin-de-fer du Nord, that of l'Est and that of Paris-Lyons-Mediterrannée, as far as Lyons. (2) Along the Chemin-de-fer de l'Ouest, de l'Etat, and d'Orleans. (3) Along the P. L. M. from Lyons through the south of France, including Corsica and Algeria.

These officers have the inspection of regional schools under their charge, their duties being to examine into the manner in which they are conducted, the number and character of the pupils, and their general maintenance. They also have the inspection of the practical schools, of which they must examine the situation and the basis upon which each is established, the care taken of them, etc. They also preside at all investigations, conduct all examinations for admission and graduation, and examine the departmental professors, not only as to the instruction which they give at the normal schools, but also as to lectures which they hold in their departments. They also preside at the competitive examinations held for the appointment of such professors, observe their influence in the Department and see that advice given by them is intelligently followed.

The inspection of agriculture was instituted in 1841, and there are at present four inspectors-general, besides one inspector for each of

the regions into which France is divided. These officers are intrusted with the inspection of the farm schools and the examinations for entrance and graduation; with the award of prizes; the organization of and presidence over general and regional competitive exhibitions, and the preparation of programmes for the same. They are also charged with the examination into demands made for subsidies by agricultural clubs and associations; they must also make monthly reports to the minister upon the state of vegetation and the crops, and inform him of every circumstance of interest to agriculture; must examine books and documents upon agriculture addressed to the minister, and submit to him measures to be taken relating to purchases, subscriptions, etc., or to the sending of notices into the departments. These inspectors-general receive a salary of 6,000 to 7,000 francs annually, with 5,000 francs for expenses, while the regional inspectors receive 5,000 francs, with 2,500 francs for expenses.

The Phylloxera service was instituted in 1879, and is composed of three regional delegates, with three assistants, and also a special delegate for each Department, who is generally the departmental professor of agriculture himself. After the Phylloxera was discovered in Algeria an inspector, afterwards inspector-general, was also appointed for that country, with three special delegates and assistants.

The general inspection of the stud was established in 1860, its special mission being to seek, both in France and abroad, stallions suitable for restocking the various haras, and to procure them under authority of the director-general, with approval of the minister. These inspectors have surveillance over the agents sent to choose stallions, mares, geldings, etc., and also over the schools for breaking horses, riding schools, etc. They preside at horse fairs, attend races, fairs, and horse markets, also visit private studs. They also prepare plans for the distribution of stallions among various breeding stations. In 1874 this service was reorganized and now consists of one director, who is inspector-general, six other inspectors, twenty-two station directors, with twenty-two deputies, and with nine supervisors for each station.

The exhibit made by the ministry of agriculture consisted of the following articles, tables, charts, etc.:

1. *Table of agricultural division of French territory.*

	1789.	1889.
	Hectares.	*Hectares.*
Cereals, etc	13,500,000	17,440,000
Potatoes	4,300	1,488,000
Artificial meadows	1,000,000	3,253,000
Forage roots and plants	100,000	1,397,000
Industrial plants	400,000	515,000
Gardens and orchards	500,000	570,000
Fallow land	10,000,000	3,644,000
Vines	1,500,000	1,920,000
Chestnut and olive groves, osiers, etc	1,000,000	842,000
Woods	9,000,000	9,457,000
Pastures and grass lands	3,000,000	5,827,000
Landes	7,600,000	3,889,000
Uncultivated ground	2,400,000	2,200,000

2. *Table of values of arable lands, pastures, and vineyards.*

[According to Lavoisier.]

	Francs.
1789	2,750,000,000
1840	3,627,000,000
1862	7,664,000,000
1889	8,060,000,000

3. *Gilded cubes representing the sums expended by the State for agriculture (i. e., for agricultural and veterinary schools, expositions, awards, subsidies, etc.).*

	Francs.		Francs.
1789	112,800	1849	1,698,392
1799	437,000	1869	4,054,838
1829	297,000	1889	8,329,705

The credits accorded to agricultural and veterinary instructions were;

	Francs.		Francs.
1835	276,241	1875	1,891,093
1853	1,938,196	1889	*3,138,400
1869	1,974,228		

4. *Viticultural chart of France: scale* $\frac{1}{320000}$.

	Hectares.
Gironde	135,000
Champagne	48,179
Burgundy	119,724
Miscellaneous	1,616,991
Total	1,919,878

5. Cantonal chart of France, showing the population of the inhabitants living by agriculture in each department. The proportion of France as a whole is 48 per cent.

6. Chart of agricultural, forestry, and hippic instruction.

*160,000 for fields of demonstration.
145,000 for agricultural laboratories, agronomic stations.
998,000 for veterinary schools (Alfort, Lyons, Toulouse)
300,000 for Institut National Agronomique.
662,000 for three national agricultural schools.
863,400 for farm and practical schools.

7. A show case containing models of recompenses given at the regional competitions for agriculture, horse-raising, etc. Decoration of the Mérite Agricole, instituted in 1883; gold, silver, and bronze medals of various grades.

8. Objects of art awarded by the minister of agriculture at the general regional competitions. Prime d'honneur, 3,500 francs. (1) Prize of honor for practical schools, 2,000 francs. (2) General prizes for sheep, 500 francs, etc.; in all, thirty-eight prizes, of a total value of 28.350 francs.

TABLE OF FRENCH AGRICULTURE.

Capital employed in agriculture.

		Francs.
Landed capital; value of lands		91,584,000,000
Capital invested:		
Farm animals	5,775,000,000	
Material	1,395,000,000	
Seed	537,000,000	
Manure	838,000,000	
		8,545,000,000
Total		100,129,000,000

Crude products of agriculture.

Vegetable production:	
Grain and forage	7,208,000,000
Sugar beets, hops, tobacco, linseed, hemp seed, etc	378,000,000
Viticultural products	1,137,000,000
Products of kitchen and market gardens	902,000,000
Orchards, olive, nut, and chestnut groves	199,000,000
Products of woods and forests	334,000,000
Animal production:	
Horses, mules, and asses	80,000.000
Beeves, etc	1,634,000,000
Milk	1,157,000,000
Wool	77,000,000
Poultry and eggs	319,000,000
Cocoons	41,000,000
Honey and wax	20,000,000
Grand total	13,461,000,000

Average yield of wheat, per hectare.

	Hectoliters.
1815 to 1820	9.89
1871 to 1880	14.60
1881	15.79

Average price of wheat per hectoliter

	Francs.		Francs.
1756 to 1865	10.70	1841 to 1850	19.74
1801 to 1810	19.94	1871 to 1880	23.09
1811 to 1820	24.61	1881 to 1888	18.94

Production of animals.

	1789.	1840.	1889.
Equine..	2,406,000	2,818,500	2,908,500
Bovine..	7,655,000	11,761,500	13,395,000
Ovine	27,031,000	32,151,400	22,880,000
Porcine	....	22,880,000	7,147,000

Production and consumption of wheat.

Years.	Surface cultivated.	Hectoliters produced.	Industry.	Quantity employed—		Consumption—	
				For seed.	For alimentation.	Per inhabitant.	Per family.
1789	4,000,000	31,000,000	2,737,000	....	....	....	......
1831 to 1841	5,353,000	68,436,000	3,241,000	11,443,000	54,934,000	1.64	6.56
1842 to 1851	5,846,919	81,041,000	3,559,000	12,279,000	66,091,000	1.86	7.25
1852 to 1861	6,500,440	88,960,000	3,933,000	13,651,000	73,726,000	2.03	7.79
1862 to 1871	6,887,749	98,339,000	4,012,000	14,464,000	83,216,000	2.19	7.95
1878 to 1888	6,904,503	100,295,000	....	14,499,000	92,444,000	2.50	8.93
1889	6,958,200	109,453,000	....	....	103,300,000	2.70	9.77

Production and consumption of meat.

Year.	Production.	Value.	Consumption per inhabitant.
	Kilos.	*Francs.*	*Kilos.*
1789	450,000,000	203,000,000	17.00
1812	503,500,000	402,000,000	17.16
1840	670,000,000	536,500,000	19.94
1852	833,000,000	850,000,000	23.19
1862	945,000,000	1,110,500,000	27.10
1889	1,190,000,000	1,632,000,000	30.36

OTHER ORGANIZATIONS.

"Men have at all times," says M. Tisserand, "sought to make progress in agriculture, but the means have varied. During many centuries it has been imagined that agriculture, being in everything, existing everywhere, might be exercised without any special instruction. Everyone, even the most dull in capacity, was considered suitable for agricultural pursuits. Minds of advanced thought caught a glimpse of progress to be realized, but the field of their action was most limited. Books of precepts were published; some few adepts profited by them, but the masses of soil-tillers remained in ignorance, slaves to rude methods and burdened with tithes and taxes. The true awakening of agriculture began at the end of the last century, when the immortal Lavoisier signalized the value of scientific teaching and endeavored to realize it by introducing into one of his farms his method of research, thus managing to double its revenues." (*m-supra.*)

Toward 1763 Moreau de la Rochette created agricultural instruction at his estate at La Rochette, near Melum, founding a school of agriculture, or rather of arboriculture, which was closed in 1780.

In 1771 Peaucellier founded, with the support of the comptroller-general, Bertin, a school of agriculture at Asnel, near Compiègne.

In the time of the First Republic, 1795, the Duke of Bethune-Charost presented to the convention a project for rural instruction in France. At this same convention Thibaudeau proposed to create at the gates of Paris an experimental farm. The Abbés Rozier and Grégoire published a project for a decree establishing an agricultural school in each Department. This idea was not carried out, but resulted in the creation of a professorship of rural economy at the museum, of which Thouin was the first professor.

In 1802 François de Neufchâteau presented a complete scheme of organization of experimental schools and farms, but France, then at war, could not successfully give her attention to agriculture.

In 1819 Mathieu de Dombasle founded, with great trouble, the school at Roville, near Nancy. His schools and labors have assured the perpetuation of his fame which time has not yet diminished. In 1822 he opened a school of agricultural instruction, a distillery, and a factory for agricultural implements. He struggled courageously, and was able to obtain a subsidy of 3,000 francs, which maintained him until the expiration of his lease in 1842. The impulse given by Dombasle and the reputation of his school found imitators.

Royal Agronomic Institute at Grignon, 1827.—The first of the followers of Dombasle were Auguste Bella and Polonceau, who in 1827 founded a society for the cultivation of the royal domain of Grignon.

Institute at Grand' Jouan, 1829.—Some time after the creation of the Institute at Grignon, Jules Rieffel founded a similar establishmenint Brittany, upon the domain of 500 hectares called the Landes de Grand' Jouan. In 1842 the Government promoted this establishment to the rank of an agronomic institute, and in 1848 it became a regional school.

Farm-school at Trois-Croix, 1832.—This was founded near Rennes in 1832, upon a very modest though substantial basis, by Bodin.

Agricultural Institute at Saulsaie.—The same attempt made by Rieffel in the *landes* of Brittany was made by Nivière upon the domain of Saulsaie, at 25 kilometers from Lyons, upon the then desolate and unhealthy plateau of Dombes. The administration came to the aid of Nivière in yielding to the request expressed by the general council of the Department of Ain, by the agricultural society, and by all the authorities of the Department; the Model Farm of Saulsaie was formed, or rather an agricultural school, the administration undertaking the remuneration of the professors as well as the expense of instruction.

The institutes of Coëtbo and of St. Agneau are only mentioned as a matter of record; they were both founded in 1833.

The administration called to its aid the general council of agriculture in 1845. After a lengthy discussion the institutes were admitted as secondary schools of agriculture, while the farm schools were

considered as the first degree of this instruction. Besides this the creation in the environs of Paris of an establishment of superior order was demanded which should promote science applied to agriculture and which, under the name of experimental farm, should be devoted to scientific experiments. Since 1846 all farm schools have been established upon an almost uniform basis.

In 1847 there were nine such schools in existence, but Grand' Jouan (or Rieffelland) and Trois-Croix are the only ones now remaining. Ten new ones were created in 1847, and six in 1848. Of these only four remain, viz: Grand' Jouan (Loire Inférieure), Trois-Croix (Ille-et-Vilaine), Besplas (Aude), Chavaignac (Haute Vienne).

The twenty-one farm schools with a few agricultural colonies constitute in France the first degree of agricultural instruction, as the three institutes form the second.

AGRICULTURAL COLONIES.

Instructions of the same order as that at the farm schools, though less methodical, is given in the agricultural colonies. These are generally charitable establishments opened to orphans or *enfants abandonnés*, or to children of poor parents or those placed there by hospitals. Some of these colonies are also penitentiaries for the reception of young prisoners.

There were eleven such colonies, of which the best known was that of Mettray. The administration has always aided these colonies, and not only encouraged them but wished to do more in attempting the diffusion of agricultural instruction throughout the territory. The project for this instruction was presented July 17, 1848, and voted upon at the proposition of Richard de Cantal, October 3, 1848. Three sorts of education were established: The first degree in the farm schools and agricultural colonies; the second degree intermediary instruction in regional schools; and the third degree superior instruction in an agronomic institute, established upon a State domain near Paris.

In conformity with this statute we find, in 1848, seventy farm schools, eleven agricultural colonies, four regional agircultural schools (Grignon, Grand' Jouan, Saulsaie, St. Agneau), and one agronomic institute, established at Versailles, which was afterwards (1852) suppressed. Finally, to complete the list, we find departmental professorships.

Under the third or present Republic agriculture has derived a new impetus; the Government has always been solicitous for its welfare, and among the various laws passed in its behalf the following are the most important:

December 19, 1873: creating a school of horticulture in the kitchen garden of the château at Versailles.

May 29, 1874: reëstablishing the stud-farm school at Pin, and also the *jumenterie*, or breeding place for mares at Pompadour, and increasing the number of stallions to 2,500.

July 22, 1874: establishing a prize of 300,000 francs for the invention of an efficacious method of destroying the grape phylloxera.

May 27, 1875: forbidding the importation into and the transit across France of potatoes coming from the United States or Canada, in order to afford protection against the Colorado potato beetle. Up to 1889 this insect had never appeared in France.

July 30, 1875: upon the organization of practical agricultural schools.

August 9, 1876: reorganizing the National Agronomic Institute.

December 15, 1877: detaching the forestry administration from the ministry of finances, and attaching it to that of agriculture and commerce.

July 15, and December 26, 1878, and August 2, 1879: important regulations concerning the phylloxera.

August 23, 1878: reorganizing the Société Nationale d'Agriculture de France, (dating from 1761) and giving it an organization similar to that of the Academy of Sciences.

April 11, 1879: adding 300,000,000 francs ($60,000,000) to the appropriation for parish roads, thus greatly encouraging agriculture by facilitating the transportation of farm products.

June 16, 1879, and June 9, 1880: organizing departmental professorships of agriculture.

October 21, 1881: reorganizing the veterinary schools.

November 14, 1881: establishing a separate portfolio for the minister of agriculture, and making this independent; also greatly extending its powers.

March 28, 1883: making agricultural instruction obligatory in primary schools.

May 15, 1882: France, Germany, Austro-Hungary, Switzerland, and Portugal agree, April 29, upon certain mutual actions and precautions against the phylloxera; which law is rendered executory in France May 15.

August 3, 1883: concerning the destruction of wolves. (In 1883 there were 1,316 wolves killed in France: in 1888 only 529. It is probable that before many years the wolf will be extinct throughout France.)

March 21, 1883: protecting Algeria against phylloxera.

July 7, 1883: instituting the order of *Mérite Agricole*, as a distinction for those who have benefited agriculture.

March 31, 1884: organizing professional syndicates.

July 29, 1884: imposing a tax upon crude sugar-making material (beet roots) and according bounties for sugar-making, thereby saving this industry from ruin.

August 11, 1885: creating a committee which should direct the work of agronomic stations and laboratories.

October 31, 1885: instituting prizes to recompense small cultivators (those holding less than 30 hectares), who, previous to this decree, were excluded from taking prizes at the regional fairs, and who comprise nineteen-twentieths of all the cultivators of France.

December 19 and 24, 1885: circulars addressed by the minister to departmental professors, prefects, and others, concerning necessary regulations for demonstration and experiment fields.

March 14, 1887: tending to repress frauds in the manufacture of butter, especially in the matter of margarine.

February 4, 1888: concerning frauds in the selling of fertilizers, dealers being required to inform the buyer of the nature of the fertilizer sold, with percentage, composition, etc.

February 19, 1889: a law having for its object the furtherance of agricultural credit, and to afford to the farmer greater facilities for borrowing money.

April 4, 1889: for applying to the peninsula of St. Germain the system of irrigation with the sewer water of Paris which is now so successful at Gennevilliers.

In addition many changes in the interest of agriculture have been made in the tariff of custom duties from time to time.

The following comparative table of the number of establishments for agricultural instruction in France in 1870 and in 1889 will show what advance has been made in this direction by the third Republic:

TABLE OF THE ESTABLISHMENT OF AGRICULTURAL INSTRUCTION IN FRANCE.

I.—Superior instruction of schools of pure scientific teaching.

1870.	1889.
None.	National Agronomic Institute, Paris.
"	21 professors.
"	7 conference masters.
"	4 masters of works.
"	17 tutors.
3 veterinary schools.	3 veterinary schools.
18 professors.	24 professors.
9 masters of works.	18 masters of works and tutors.

II.—Establishments of scientific instruction combined with practical teaching given in a farm or estate.

1870.	1889.
3 national schools of agriculture.	3 national schools of agriculture.
19 professors.	26 professors.
16 tutors and preparers.	23 tutors.
	1 national school of horticulture at Versailles.
	12 professors.
	3 practical masters.
	1 school of horse-breeding at Pin.
	7 professors.

III.—Establishments or schools of agricultural teaching, theoretic and practical, adapted to the needs of young men belonging to small farms and receiving children on their leaving the primary schools.

1870.	1889.
1 school of irrigation and drainage at Lezardriaux.	2 practical schools of agriculture and irrigation.
1 professor.	6 professors and masters.
	14 practical schools of agriculture.
	73 professors.
	22 practice masters.
	14 military instructors.
	2 practical schools of agriculture and viticulture.
	11 professors.
	3 practice masters.
	2 military instructors.
	3 practical schools of dairy farm.
	11 professors.
	6 practice masters.
	3 military instructors.
	2 professional primary schools.
	4 professors.
	1 practice master.
	1 military instructor.

IV.—*Practical schools or schools for apprenticeship.*

1870.	1889.
52 farm schools, more than half of which were in jeopardy.	17 farm schools. Pastoral schools. 2 schools of silkworm nursery. 1 school of arboriculture. 6 cheese dairy schools. 2 milk dairy schools for girls.

V.—*Agricultural teaching annexed to establishments of general teaching or universities.*

1870.	1889.
4 chairs of agricultural chemistry in science faculties. 10 departmental chairs of agriculture, organized by the departments.	5 chairs of agricultural chemistry in faculties. 90 chairs of agriculture (departmental) organized by the State. Course of agriculture in lyceums, colleges, and superior primary schools; obligatory agricultural teaching in primary schools.

VI.—*Establishments of agronomic research.*

1870.	1889.
6 agricultural stations and laboratories.	41 stations and agricultural laboratories. 1 milk dairy station. 1 station for testing grain. 1 station for testing agricultural machines. 1 station for the study of the diseases of plants. 1 station for the study of fermentations. 1 technological laboratory, brewery, sugar refinery, experiment and demonstration fields organized in all departments.

The following is the present order of importance of the various schools under the ministry of agriculture:

I.—*Agricultural Instruction.*

1. National Agrononic Institute at Paris.
2. National schools of agriculture: At Grignon, near Neauphle-le Chateau (Seine-et-Oise); at Grand' Jouan Nozay (Loire-Inférieure); at Montpellier (Hérault).
3. National School of horticulture at Versailles.
4. Practical agricultural schools: Twenty-seven in all.
5. Farm schools: Seven in all.
6. Primary agricultural schools and institutions of practical instruction: Thirteen in all, viz, six schools for cheese-making, of which four are in Haute-Savoie and two in the Département de l'Ain; two schools for sheep-raising, one at Rambouillet and the other in Algeria; one school for arboriculture and a nursery for trees, both in Corsica; a sericicultural school at Aubenas (Ardèche) and two other general schools.

7. Departmental professorships of agriculture and courses in normal schools: There are ninety of these in all, one for each department of France or of Algeria.

8. Professorships of agricultural chemistry in faculties of science: There are several, of which those at Caen, Bordeaux, Toulouse, Rennes, Nancy, Lyons, Marseilles, and Montpellier are the most notable.

9. Courses of agriculture in lyceums, colleges, superior primary schools, and professional schools: Seventeen in all.

10. Agronomic stations and agricultural Laboratories: Fifty-six in all.

II.—*Forestry Instruction.*

1. Forestry schools at Nancy (Meurthe-et-Moselle).
2. School of professional instruction in sylviculture at Barres (Loiret).
3. Primary schools of sylviculture, also at Barres.

III.—*Veterinary Instruction.*

Veterinary schools at Lyons (Rhône), Toulouse (Haute-Garonne), and Alfort (Seine).

IV.—*Instruction in Stud Farming.*

School at Pin (Orne).

THE NATIONAL AGRONOMIC INSTITUTE AT PARIS.

The statute of August 19, 1876, reconstituted the National Agronomic Institute suppressed at Versailles September 17, 1852.

All students are day scholars and must certify that they were 17 years of age on the 1st of January of the year in which they present themselves for admission.

Every year six purses of 1,000 francs and four of 500 francs are distributed, each giving the right to free instruction, and ten other purses are put up for competition. These purses (or what we should call scholarships) are allowed by the minister of agriculture, according to rank of scholarship, and for the school year, to pupils who have successfully passed the examination for admission and whose families have previously proved the insufficiency of their means. These purses may be withdrawn during the year as a measure of discipline.

The professors receive a stipend of 150 francs per lesson, but their whole salary cannot exceed 7,500 francs ($1,500) annually.

The object is to educate the pupils to be: (1) agriculturists; (2) special professors for agricultural instruction in the national agricultural schools, in the practical schools, in the departments, or in the normal schools; (3) educated and capable administrators for various public or private services, such as inspectors of agriculture, service in the haras, the Phylloxera service, or the central agricultural administration; (4) agents for forest service; (5) directors of agronomic stations; (6) chemists for agricultural industries; (7) agricultural engineers.

At its creation the institute was installed in the buildings of the Conservatoire des Arts et Métiers. The commission of re-

organization thought best not to give the school any large cultural domain, but simply an outfit for research and experiment at the farm of the Faisanderie, under the name of the "Experimental Farm of the Agronomic Institute."

In January, 1888, a decree of the President of the Republic decided that from 1889 all the pupils of the national forestry school should be chosen from among those pupils of the institute who had received diplomas, thus following the method adopted at the polytechnic school for the recruiting of the school of application, without, however, the exception established in favor of graduates of the polytechnic.

The duration of the course of study is 2 years, separated by 3 months' vacation, of which at least 2 months are to be devoted to the practice of agriculture and to the preparation of memoirs which have an influence upon the standing at graduation.

The personnel of instruction comprises twenty-one professors, seven *maîtres de conférences* (lecturers), four chefs de traveaux, and seventeen *repetiteurs* (tutors). The courses are completed by *conférences* (lectures), which are practical exercises, and which are divided into agricultural and industrial excursions among the most remarkable establishments in the environs of Paris. The pupils must keep account in special books, as they also must of visits of regional fairs and horse shows, etc.

All the courses and exercises of this instruction are obligatory. All notes given are condensed to a mean which serves to establish the merit and class standing of each pupil. Thanks to this system the attention of the pupils is controlled and they are not distracted from their studies. Although they are free after 5 p. m. they occupy their evenings in reviewing the two or three lessons (generally from one-half to 1¼ or 1½ hours) which they have received during the daytime, and in preparing for the examinations which they undergo each week upon the lectures which they have attended. At the end of each course they have a general examination, so managed that all the pupils are questioned at the end of each series of ten lectures of the course, or upon the termination of the entire course.

The rank of graduation results from the combination of the two ranks at the end of the two years, with the notes upon the one in vacation time, and those of special practical tests, called practical graduation tests. Each of these elements has soecial influence upon the final rank.

The rank of graduation determines the right to the following advantages:

(1) To a diploma of superior agricultural instruction for each pupil judged worthy of it.

(2) To a complimentary mission at the state's expense, either in France or abroad, for 3 years for the two pupils first on the list of graduation.

(3) To admission to the school of forestry application, at Nancy, with a purse of 1,500 francs for the ten or twelve pupils (according to the needs of the forestry corps) who are classed highest among those who wish to make their career in the forestry administration.

(4) To a position called the "third year position," either in the laboratories of the institute or in the agricultural or industrial exploitations, with an allowance of 100 francs per month, for the nine pupils having the highest work among those who demanded it. This system of weekly and general examinations and of various ranking has been adopted from that of the central school of arts and manufactures, where it has long been in use. It stimulates work among the pupils, and allows of giving of diplomas or favors only to those who have actually earned them.

The study missions (*missions d'études*) were created by the decree of August 9, 1876, and they have allowed pupils to acquire agricultural practice which was wanting and a knowledge of foreign languages which has been indispensable. These missions have successively been accomplished in England, America, Germany, Italy, Spain, Switzerland, Holland, Algeria, and Tunis.

The number of pupils has constantly been increasing, viz:

Year.	Candidates.	Pupils.	French.	Foreign.
1876	32	26	20	6
1880	51	23	35	8
1883	80	63	48	5
1888	120	96	86	10

The Station for testing Seeds.—Several special institutions have been annexed to the agronomic institute. The station for testing seeds, created in 1884 and completely organized since January, 1889, after the model of the station at Zurich (1876) and of that at Copenhagen (1879), is one of these.

Elementary examinations, such as the determination of the degree of purity of any seed, its germinative power, etc., tried simultaneously in different laboratories, often lead to widely differing results. Perhaps this state of things so prejudicial to the authority of the various laboratories might be obviated by establishing standard processes of analysis in which all stations might more closely agree.

Fermentation Laboratory.—The laboratory of fermentation was created by a decree of May 17, 1886, for the study of fermentation in relation to the brewing and distilling industries, as also to vinification and dairy work. As a result of the brewing exhibition of 1888 the brewers demanded the creation of a special laboratory where they could consult either upon yeast or upon abnormal phenomena or fermentation, often happening so as to discommode their work.

Laboratory of vegetable Pathology.—This laboratory was created in 1888 by ministerial decree on August 24, and was destined to enlighten farmers concerning diseases which attack plants. All samples sent to the laboratory are examined gratuitously. If the disease is due to a parasite the genus of this is determined and the name is sent to the cultivator with advices as to the remedies to be used, whenever such information is possible. The departmental professors must be collaborators of the pathological laboratory and of its correspondents throughout France.

Station for Trial of agricultural Machines.—This station created by ministerial decree January 24, 1888, was presented by the municipal council with a piece of land containing 3,309 square meters at No. 47 Rue Jenner, Paris, to be held for fifteen years. Its object is to appraise agricultural machines as to their mode of working and as to the motive power which they require.

The machines sent by their inventors, their constructors, or by other agents are submitted at the station to various trials and afterwards, if necessary, to practical trial more or less prolonged upon one or more agricultural fields. The principal points of the examination bear upon: (1) The mechanical work of the machine; (2) the quality of work done; (3) the expense of working; (4) construction; (5) approximate use. At the end of the trial a bulletin of trial is made out by the director of the station giving the results obtained. This bulletin may be published by the inventor as an advertisement and constitutes an official document for the mechanic and a warranty for the purchaser.

Objects exhibited.—The institute made an interesting show of objects illustrating the work done and instruction given, the most notable of which were as follows:

Iron and wooden models illustrative of the history of the plow, together with several plates after ancient designs.

Collection of phosphates illustrative of agricultural geology.

Tables showing researches made at the institute upon the development of root systems and upon the use of fertilizers.

Models of apparatus for study of vegetation in sterilized soil, for study of ferments, for analysis of butter, for estimation of sulphocarbonates, etc., for absorption of atmospheric ammonia.

New saccharine bodies: Perseite, Byrsomine, and Achrasite, all discovered at the institute.

From the laboratory of agricultural pathology were exhibited thirty-nine cartoons, showing parasitic diseases of leguminous plants, grain plants, vines and trees; table of experiments upon black-rot carried on at Aiguillon by order of the minister of agriculture; table to prove that M. Duchartre, professor at the old agronomic institute at Versailles, was the first to show (1850) the efficacy of sulphur against oidium.

The station for testing seeds exhibited a self-regulating oven of constant temperature; also a plan of the station, and numerous tables of results obtained.

The fermentation laboratory made an exhibit explanatory of the application of its work to brewing and to wine and cider making, also to distilling and dairy work. It also illustrated the cultivation of various ferments.

There was also an exhibit of the annals of the institute, and of various works published by its professors or former pupils. A few of the titles are here mentioned to show their nature: "Grass Lands and Natural Prairies," by M. Boitel; "Poisonous Plants," by M. Cornevin; "The Horse: His Relation to Rural Economy and to the Industry of Transportation," by M. Lavalard; "Experiments upon Farm Production," by MM. Müntz and Girard; "Report upon the Preservation of Green Fodders" and "Agricultural Geology," by M. Risler; "Cider Apple Trees," by M. Nanot; "Researches upon the Development of the Sugar Beet," by M. Girard; etc.

NATIONAL SCHOOL OF AGRICULTURE AT GRIGNON.

It was in 1827 that Auguste Bella and Polonceau, with the support of the Duc de Doudeauville, minister of the house of Charles X, formed a society with a capital of 300,000 francs for the exploitation of the royal domain of Grignon, near Neauphle-le-Chateau (Seine-et-Oise), containing 500 hectares, upon condition of making 300,000 francs' worth of improvements in 40 years.

According to the terms of agreement this society proposed: (1) To cultivate the domain in accordance with the best advice of the most distinguished agriculturists; (2) to found two schools, of which one was designed to give instruction in applied sciences, as mathematics, physics, chemistry, botany, and veterinary medicine; the other was to make farm foremen by instruction in good agricultural practice. This last school was never founded.

In 1832 the society received a "commencement d'exécution," with a subsidy of 3,000 francs, raised to 8,000 francs in 1833. In 1836 the Royal Agronomic Institute at Grignon received from the appropriation for agricultural encouragement a sum of 19,000 francs, raised to 26,000 in 1837. Finally, in 1838 a decree of March 31 charged the state with all expenses of instruction, besides which the school received an allowance of 33,000 francs, raised to 35,000 francs in 1839. The house pupils had then only to pay 1,200 francs annual fees, instead of 1,500; dormitory pupils only 850 francs, instead of 1,300, and day pupils only 150 francs, instead of 200. By the statute of October 3, 1848, the agricultural institute at Grignon was transformed into a regional school.

The actual extent of the domain is 500 hectares (1,235 acres), consisting of pastures, woods, and arable lands.

The administration consists of one director, one subdirector, one accountant with two clerks, etc.

The personnel of instruction comprises nine professors and nine tutors, corresponding to the following courses: Agriculture—zoölogy and zoötechny; physics, meteorology, and agricultural geology; rural engineering—mechanics, machinery, hydraulics and construction; general and agricultural chemistry; technology, rural economy and legislation; botany; sylviculture.

The professors are chosen by competitive examination, and are divided into three classes, at salaries of 4,000, 5,000, and 6,000 francs.

The tutors are chosen by the professors, submitted to the approval of the director, and are appointed by the minister of agriculture; they are divided into three classes, at 1,300, 1,500, and 1,800 francs. They are lodged, boarded, etc., at the school, and are chosen from among the former pupils of special chemical schools, from those of the École Centrale, or of various agricultural schools.

Lectures upon entomology, hygiene, horticulture, market gardening, dairy work, bookkeeping, mathematics, algebra, trigonometry, agricultural practice, exercises in zoötechnics, and analytic chemistry are given once or twice a day by instructed agriculturists.

There are three categories of pupils: (1) Boarding pupils, lodged and boarded at the school; (2) day scholars, who have the same work and instruction as the former, but who board and lodge outside of the school; (3) free pupils, admitted to follow freely the course of instruction, and not subjected to examinations.

The price of board is 1,200 francs for boarding pupils, and 200 francs for day scholars and free pupils. The duration of the course is 2½ years. The school year commences on October 15, and ends at the end of March of the third year. Vacations commence at the end of July and end October 15. During these vacations the pupils must follow the work upon a farm and write a detailed report upon their observations. Each month the pupils must pass, before special instructors, an examination upon each monthly course; these examinations, in connection with those at the end of each term and at the end of the course, give the standing of each student at the end of each year. A report upon the work and conduct of each pupil is sent to his parents every three months. The school is maintained at the expense of the state, and the price of board paid by the students simply covers the expense of materials for instruction.

The school made an exhibit consisting of the following articles:

Table showing the distribution throughout France of two thousand graduates of the school since its foundation.

Plans of excursions made by the pupils under direction of their professors, from 1870 to 1885.

Collection of woods, collection of fossils of Grignon, collection of samples of soil, collection of plants and seeds; all made by the pupils.

Table of results of the agronomic station, tables of net prices of beef and mutton, and of production, consumption, and prices of wheat and bread in France.

Publications by professors and former pupils, some of the titles of which are as follows: "Cattle and Customs Duties," "Culture of Experiment Fields," "Value of Fertilizers," "Loss and Gain of Nitrogen in Arable Soils," "Researches upon the Respiration of Leaves in Darkness," "The Cultivation of Oats," "Researches upon Farm Manure," "Recent Progress of Dairy Industry in Denmark and Holland," "Treatise upon Kitchen Gardening," etc.

NATIONAL AGRICULTURAL SCHOOL AT GRAND 'JOUAN.

Some time after the creation of Grignon, in 1829, Jules Rieffel, a pupil of the school at Rouilk, laid the foundations of a similar establishment at the domain called the Landes de Grand 'Jouan in Brittany, between Rennes and Nantes, containing 500 hectares, four-fifths of which were still fallow. This enterprise, also, was carried on by a society which furnished capital, the duration of the society being fixed at twenty years. It commenced with a primary agricultural school intended for poor young peasants, in order to make them good farm hands or overseers. Subsidies were obtained from the Department of Loire-Inférieure and from the Government.

These subsidies, continued from year to year, afforded M. Rieffel the means of sustaining and developing this work in adding to the primary school an agricultural school and a factory for implements (perfected plows). In spite of this the establishment did not prosper, and M. Rieffel asked the Government to transform his school into a regional institute at the State's charge, the State to pay for instruction and to found scholarships (*bourses*).

By decree of March 9, 1842, upon a favorable report of the inspector-general of the region, the organization of the institute was proceeded with. The personnel of instruction comprised: One director, who was also professor; four professors in addition; one master irrigator; one master shepherd. The course of instruction was fixed at two years, and the State gave twenty-four scholarships at 500 francs each and a sum total of 26,700 francs. Rieffel continued to cultivate his domain on his own account.

In 1844 the price of board was fixed at 700 francs, entrance fee not included. In 1846 the ministerial subsidy reached 18,000 francs for instruction and 30,000 francs as total annual allowance. In 1847 this sum for instruction was again raised to 25,000 francs. In spite of all this the institution went backward, when the decree of October 3, 1848, saved expense to the State by converting it into a regional school.

At present the school comprises 97 hectares, let at 33 francs per

hectare, the price increasing 3 francs every three years. The lease is granted until the year 1936.

The instruction is the same as that in the other agricultural schools.

The number of pupils is now about 50 to 65 candidates, with 35 to 45 admissions yearly. Since 1849 diplomas have been given to 293 pupils; 21 are departmental professors of agriculture, 5 are directors or deputy directors of practical schools or farm schools, and 6 are professors or school directors abroad.

The school made an exhibit of its progress similar to that made by the school at Grignon.

NATIONAL AGRICULTURAL SCHOOL OF MONTPELLIER.

The present school of Montpellier, at La Gaillard (Hérault), is only a continuation of that at Saulsaie, in Dombes, which, like Grand 'Jouan and Grignon, was transformed into a regional school.

Neither of these three regional schools represented the agricultural interests of the South of France. As a consequence of innumerable demands, the State decided in 1869 to transfer the school at Saulsaie to Montpellier, the first examinations for admission to the new school being finally fixed for December, 1872. The school progressed but slowly from 1872 to 1876, after which date it took rank among the more important institutions of Montpellier. Having personally visited this school on several occasions, I can speak from knowledge of the efficacy and excellence under its present director, Prof. Foëx.

The instruction given at this school has gradually increased. In 1872 there were but seven professorships, viz.: Physical and chemical science, botany and sylviculture, rural economy, zoötechny and zoölogy, agriculture, rural engineering, technology.

Four other professorships have since been created: Entomology apart from zoölogy, physics, geology and meteorology apart from physical and chemical sciences, viticulture apart from general agriculture. Eleven principal branches, not including horticulture, bookkeeping, and agricultural practice, are now normally carried on.

The domain, lying at the city gates and having an extent of 28 hectares, with its stables, cellars, garden, cattle, machines, cultivation, etc., furnishes important resources for practical work and agricultural observation. Frequent excursions among neighboring farms, and also excursions to greater distances, add to the instruction of the pupils.

The school at Saulsaie contained no boarding pupils (*internes*). When that at Montpellier was organized, provision was made for 40 day-scholars (*externes*), and afterwards, upon the demands of certain families, provision was made for 20 boarding pupils in 1876, this number being increased to 80 in 1882, so that now, like all the

national agricultural schools, this school has both day and boarding pupils and free scholars (*auditeurs*). The day scholars arrive at the school at 8 a. m., dine there, and leave at 4 p. m.

Since the foundation of the school, 554 regular pupils and 184 *auditeurs* have been enrolled. Of 442 French pupils, 123 have received diplomas, and also 43 foreigners out of 112.

Services relating to various branches of theoretical and practical education are allotted to the pupils. These comprise cultivation, care of animals and of farmyards, engineering and the making of machines, work in experimental fields and gardens, in the botanical school and its collections, the making of meteorological observations, and other services according to need. Each service is allotted to a pupil of the second and two of the first year. These pupils (*élèves de service*) are required to come each evening at a fixed hour, to take orders for the next day's work and to copy them out into registers for the purpose.

The Sericicultural Station.—The foundation of this station at Montpellier dates from January 1, 1874. Five years previously M. Pasteur had published his important discovery concerning the diseases of silkworms, especially the pébrine, which had almost destroyed silk-culture in France, and his processes of selection were only known to a few persons. A certain number of adepts held a monopoly of this special work, which resulted in the majority of silkworm-raisers being ignorant thereof. It was therefore necessary to spread over the country the knowledge of Pasteur's methods and to teach the use of the microscope and in other ways to combine the latest knowledge in examining the parent moths for pébrine and securing sound eggs. M. Maillot, whose sad death was announced soon after the Exposition closed, was a pupil of Pasteur's. From 1865 to 1869 he was charged with a sericicultural mission to Corsica and Italy and was afterward placed at the head of this annex of the school at Montpellier.

In 1876 an *emploi de stagiaire* was created, which was transformed into a deputy directorship in June, 1877. This deputy director was then specially charged with the entomological course. From 1880 the sericicultural station was fully incorporated with the school, and now forms one of its most important branches. A special building is devoted for the uses of the station, and comprises a hall for collections, three rooms for raising silkworms, a mulberry room, a small laboratory ; a hothouse, for growing the mulberry, is heated by a thermo-siphon, and furnished leaves in February and March enough to nourish several hundred worms for anatomical study. The normal rearing of worms is done with mulberry leaves grown upon plantations upon the school domain.

There are twenty lectures in sericiculture given by the director of the station to pupils of the second year, in the winter term. The

summer term is reserved for practical lessons in micrography and for rearing of worms. The pupils may imitate or may take part daily in the practical rearing. The station is always open to delegates of agricultural clubs or to foreign visitors.

A circular of October 27, 1887, charges the departmental professors of agriculture with lectures upon sericiculture and microscopy in the normal school of the silk-growing regions, besides which the rearing of a small quantity (3 to 4 grammes) of silkworm eggs must be practiced at each school. The director of the station at Montpellier has surveillance over this instruction.

Even more important than this sericicultural work is the viticultural work, especially in the study of Phylloxera and experiments with American resistant stock, and of late years, with regard to the fungous diseases of the vine, particularly with the Peronospora so recently introduced. In fact Montpellier has been the center of information and experience in all things pertaining to the Phylloxera, and the school at Montpellier has consequently been the chief source of authoritative information on the subject. Admirably situated in the midst of the vast vineyards of Hérault the school has been fortunate in its director who is himself interested in everything pertaining to grape-culture.

The school made an exhibit as follows: Plan of the school; photographs of lecture room, etc. Books of professors' lectures, and instructors' questions. Map showing distribution of pupils of the school. Herbarium: Collection of grape-seeds, models, etc. Description of American vines cultivated at Montpellier with a collection of vines made from them at the school. Collection of oil paintings representing various diseases of the vine.

Publications: "Diseases of the Vine," by M. Viala; "A Complete Course of Viticulture," by M. Foëx; "Cultivation of the Vine in the sands of *les Landes*," etc.

The exhibit of the sericicultural station was as follows: Collection of silkworms and cocoons raised at the station. Model of a hatching machine ("Castelet de Cévennes") for silkworm eggs. Frame containing material, apparatus, etc., necessary for examination of silkworm eggs by Pasteur's method.

Publications: "Treatise upon Silkworms," by M. Malpighi; "Lessons upon the Mulberry Silkworm;" memoirs, documents, etc., upon sericiculture.

NATIONAL SCHOOL OF HORTICULTURE AT VERSAILLES.

This was created by a decree of December 18, 1873, and established the kitchen garden of the château of Louis XIV. The school receives day pupils (*externes*) and the instruction is gratuitous, the duration of the course being three years. The initiative in this was taken by M. Joigneaux, sr., deputy for Côte d'Or.

Numerous courses are given there. Certain of these complete the elementary instruction of pupils, but the greater number exclusively relate to technical instruction. The kitchen garden has also undergone a change to adapt it to its new usage. It was formerly entirely given up to the growing of fruits and vegetables, but is now an experimental garden. Numerous collections have been furnished and a botanical school has been organized with, at present, 1,900 specimens.

An open air garden contains a fine collection of over 600 varieties of rose trees of the best sorts. There are also rhododendrons, azaleas, etc., and annuals, bulbs, etc., are also cultivated. A small nursery of half a hectare gives the pupils an idea of tree-raising in the open air, and also of grafting, etc. The kitchen and market garden reputation of the garden at Versailles is still kept up, but the collections of fruit trees suffered greatly in the winter of 1879–'80, and many varieties then destroyed by frost have never been renewed.

The practical character of the school as regards cultivation has been retained, while an important instructive development has been given to it. A large winter garden, 48 by 10 meters, and 9 meters high, shelters specimens of palms, ferns, cycades, etc. Besides this there is a greenhouse 80 meters long with a central pavilion, and four other greenhouses containing ornamental plants which the students have an interest in studying. A collection of orchids has been commenced. Grape and peach houses complete the collection, and small greenhouses for multiplying have been lately established.

The instruction given includes culture of fruit trees in the open air; pomology; fruit culture in nurseries; ornamental arboriculture; forestry, including the nursery in general; kitchen gardening, both by forcing and open air culture; floriculture in open air and under glass; elementary and descriptive botany; principles of architecture for gardens and greenhouses; elementary notions of physics, meteorology, chemistry, geology, mineralogy, etc., applied to cultivation; elements of zoölogy and entomology, and their relations to horticulture and arboriculture; arithmetic and geometry applied to the needs of gardening; linear drawing—drawing of plants and instruments; lessons in the French language and in bookkeeping; lessons in the English language, and military exercise.

The practical instruction is manual and rational. It is given by the director and the principal gardeners.

The pupils are required to attend from October 1, when the school year opens. At that time an examination takes place which serves to award the state scholarships. These scholarships are awarded for a year and may be divided.

Pupils who have passed the examinations for graduation receive a certificate from the minister of agriculture, upon proposition by the examining jury. Pupils who graduate with the highest rank

may receive an appointment in French or foreign establishments. An allowance of 1,200 francs is made for each appointment, the number of appointments never being over three.

PRACTICAL AGRICULTURAL SCHOOLS.

As their name indicates, the practical schools are essentially professional schools for agriculture. They are intended for young men well prepared by previous study, who wish to acquire serious agricultural instruction, both theoretical and practical. M. Henry Grosjean, whom I first had the pleasure of meeting when, some years ago, he was on a mission to this country to study agricultural institutions, is now prominently identified with these schools, and the following account is largely drawn from a paper of his on the subject.

As regards instruction, these schools hold an intermediate place between the farm schools and the national schools. If the farm school represents primary agricultural instruction and the national school secondary instruction, the practical school constitutes the primary-superior agricultural instruction. At the farm school the instruction is almost exclusively practical, while at the normal school theoretical instruction predominates. Holding a position between these two, the practical school affords each kind of instruction.

Since July 30, 1875, twenty-seven of these schools have been formed, and several others are in process of formation. These practical schools are not State property, but belong to a Department or to a private individual, while the State gives the agricultural instruction.

In certain cases, as when a Department is poor, the State may participate in the expenses of establishment and of instruction. The proprietor who offers his domain for the establishment of a school generally has recourse to departmental aid for the construction and management of the buildings and purchase of material for instruction. The proprietor advances money, the department reimbursing him by means of annuities. In such a case there are combined shares of the State, Department, and individual.

The proprietor or farmer whose domain is accepted by the administration becomes director of the school. In addition to the fees paid by the pupils, he receives a salary fixed by the State. When it is the Department which is proprietor it chooses a director (*régisseur*), or farmer, who, upon sanction by the minister, becomes director. These schools are always subject to the control of the administration.

The instruction may vary according to the school or its specialties. Thus, there may be practical schools of viticulture, of dairy work, of cheese-making, of irrigation, of drainage, or of aviculture. The extent of land varies according to the country, 30 hectares being a good average. The personnel is always variable, but generally con-

sists of: One director, who may be a professor; a professor of agriculture; a professor of physical and chemical sciences; a professor of natural history (*surveillant*); a professor for complementary primary courses; a veterinary professor, also teaching zoötechny; a chief of agricultural practice; a chief of horticultural practice, and a military instructor.

The professors of these schools are principally chosen from diploma graduates of the National Agronomic Institute or of the National School of Agriculture.

The course of study differs in different schools according to their nature, though as a basis it consists of the following subjects, more or less developed as they are needed :

(1) Moral and civic instruction*; (2) French language*; (3) agricultural history and geography; (4) arithmetic; (5) geometry, plan drawing, surveying, linear drawing; (6) physics and meteorology; (7) chemistry applied to agriculture, agricultural technology; (8) botany, geology, zoölogy, entomology, diseases of plants, etc.; (9) general agriculture and special cultivation ; (10) rural engineering (machines, rural buildings, etc.); (11) rural economy and legislation; (12) zoötechny, hygiene of animals, sanitary police ; (13) horticulture and arboriculture; (14) agricultural bookkeeping; (15) military exercise.

The majority of pupils who frequent these schools belong to agricultural families. When a school is first founded there is a large proportion of sons of employés, instructors, or commercial men, but soon thereafter the agricultural element predominates.

Before entering, the candidates undergo an examination in French, mathematics, history, geography of France. Those candidates who have primary-school certificates are excused from examination unless they wish to compete for the scholarship of the State or Department.

The school is of the boarding school variety (*interne*), but there are also day scholars and demi-pensioners. The fee is from 400 to 600 francs. Each school contains from fifteen to twenty pupils yearly. The instruction continues from two to three years, with a tendency to continue for two years only. In certain of the schools it only lasts a year, since many families of modest position do not wish to separate themselves from their sons for so long a time as two or three years.

The division of time between theoretical lessons and practical exercises characterizes these practical schools. Half the time is devoted to theoretical and the other half to practical courses. The pupils are constantly occupied by special examinations, both on theoretical and practical work. These examinations take place every week, there being also general examinations at the end of each course. The first of these examinations is upon the ten previous lessons only, given

*Nos. 1 and 2 as taught in primary and in primary-superior schools.

since the last examination, while the general examination embraces the whole course. All notes are sent, in the form of a quarterly bulletin, to the families of the pupils.

At the end of their studies those pupils who are deemed worthy receive a certificate of instruction delivered by the minister of agriculture, which is considered as equivalent to the *volontariat d'un an.*

Pupils graduated from the practical schools for the most part remain loyal to their agricultural career, and enter the national schools or the Agronomic Institute.

The necessity for these schools is universally recognized, and, as they are not costly, foreign governments annually send delegates to study their organization and methods of teaching. They only cost the state about 20,000 francs a year. Similar schools have been created in Switzerland, Italy, and Belgium.

FARM SCHOOLS.

At the time of the foundation of the schools at Grignon and Grand 'Jouan several farmers organized under the names of model farms or farm schools institutions to receive young men and to teach them by rational apprenticeship the business of the farm. The model farms had for their mission to prepare for large domains or for large farmers capable overseers or farm hands. Young men of the ages from 17 to 20 were received, performed all sorts of work, looked after the animals and even received wages, and upon quitting the farm received a certificate of proficiency.

The Republic of 1848 revived this custom and a statute credited the farm schools upon the plan of the model farms. The age for admission was fixed at 17 years. The instruction was essentially practical. The apprentices performed all the work, and the work was carried on at the expense and wish of the director, who was either proprietor or farmer. The State paid the director 175 francs per pupil per annum, and the work done by the pupils served to make up the sum necessary to indemnify the director for the expenses of maintenance and instruction, and for school expenses. Besides this the director received a fixed salary of 2,400 francs. The duration of apprenticeship was two to three years. Upon graduation the State accorded to each pupil an allowance of 75 francs for each year he had passed at the school.

The decree of the National Assembly, October 3, 1848, regarding the creation and organization of professional agricultural instruction, proposed to make a farm school in each Department, but this number has never been attained. From 75, which was their number in 1852, they fell to 65, and in 1870 there were only 50, and in 1876 only 28. At present, owing to the conversion of certain of them into practical schools, or to the suppression of others, from various causes, their number is reduced to 18.

Their personnel of instruction always consists of a director, who manages the farm on his own account. He generally teaches agriculture. A supervisor and accountant, who teaches the pupils arithmetic, geometry, surveying, etc.; a chief of practice, teaching manual work, etc.; a chief gardener, taking for horticultural pupils the same place that the chief of practice does for pupils studying general cultivation; a veterinarian, having received a diploma, who is charged with the course in zoötechny.

This personnel of instruction is invariable for all the farm schools, but is often augmented according to the needs of the region by the addition of auxiliaries, such as a chief vine culturist. chief cheesemaker, etc. These agents have a fixed salary.

The bonus of 300 francs given at graduation tq pupils who have received certificates does not compensate for the sacrifice undergone by familes in depriving themselves of the services of their children for three years, and the tendency is to limit the term to two years. The instruction is divided into two parts, theoretical and practical. The practical instruction comprises the execution of all works of cultivation, including the use of improved machinery and care of farm animals. Wherever it consists of special industries, such as viticulture or cheesemaking, the pupils are initiated in these industries.

The theoretical instruction comprises elementary lessons in agriculture and in horticulture; also in arithmetic. geometry, surveying, leveling, etc., zoötechny, and accounts.

Generally, save at the time of haymaking and during harvesting, three-fifths of the pupils' time is given to practical work and two-fifths to theoretical study.

PRIMARY AGRICULTURAL SCHOOLS.

Shepherd Schools—National Sheepfold at Rambouillet.—This was established in 1785 when Louis XVI had bought from the Duke of Penthièvre the château, parks, and woods at Rambouillet (Seine-et-Oise) and obtained from the King of Spain permission to introduce into France three hundred and sixty-four animals of the Merino race.

In 1854 the sheepfold (*bergerie*) was annexed to the imperial household, and in 1871 to the ministry of agriculture.

The establishment at Rambouillet has been the source of the great herds of Merinos which now exist in Europe and Australia, the French Merino having originated from the importations from Spain in 1786 and 1800, made by the care of MM. G. Bourgeois and Tessier.

Abont 2 kilometers from Rambouillet there is an annex for the Mauchamp race of Merinos, a variety with long, fine, silky, undulat-

ing wool, obtained in 1828 by M. Graux, at Mauchamp, from a flock of Merinos of moderate size.

The instruction given at Rambouillet is entirely gratuitous and essentially practical. It is in connection with primary instruction, and includes arithmetic, surveying, keeping of accounts, the art of maintaining a flock of sheep, and the zoötechny of the sheep.

This school had an exhibit as follows: Tables representing samples of wool from Merino ewes and rams of 3 and 5 years of age from 1786 to 1889; water color of a Champagne ewe, 1806; water color of a Beauce ewe, before the introduction of Merinos in 1786, this being the ewe with which the original cross was made; water colors of Merinos, with samples of fleece, 1800; water colors of Merinos, born at Rambouillet in 1802, sixteen years after the first importation; water colors of Merinos as imported from Spain, 1786; photographs of Rambouillet, 1889.

National shepherd School at Moudjebeur (*Algeria*).—This is constituted similarly to that at Rambouillet, save for its adaptation to the Algerian climate and for a few other details. The course continues for 3 years, and the number of pupils, who may be European or native, is fixed at twenty-five. The prizes given at graduation are also higher, the first prize being 500 francs.

DEPARTMENTAL AND COMMUNAL INSTRUCTION IN AGRICULTURE.

The creation of agricultural professorships dates from 1838, since which time they have been established in the following Departments: 1838–'39, Haute-Garonne and Doubs; 1840, Seine-Inférieure; 1841, Aveyron; 1849, Somme, Finistère, Oise; 1855, Gironde; 1872, Côtes-du-Nord.

But the true organization of departmental professors dates from the statute of June 15, 1879, relating to departmental and communal instruction in agriculture, and which ordained that, within a period of 6 years, there should be a professorship of agriculture established in every department not already so provided. The professors are appointed by a decree drawn up between the minister of agriculture and the minister of public instruction. The candidates must be Frenchmen and at least 25 years of age, and are examined before a jury composed of: The inspector-general of agriculture, president, the inspector of the academy, a professor of chemistry and physiology, a professor of natural sciences, a professor of the veterinary school, three agriculturists chosen by the departmental commission, a general councilor designated by his colleagues.

The professors of chemistry, of physiology, and of natural sciences are to be chosen from the personnel of instruction of the National Agronomic Institute or of a school of agriculture.

There are three sorts of tests: an examination in writing, two oral examinations, and practical examinations.

Departmental professors may be recalled by either of the two ministers, after consultation with his colleague. The salaries, in four categories, are 5,500, 4,500, 4,000, and 3,000 francs. Promotion from one of these categories to another may be made only after at least three years' experience.

The expenses of visiting (*frais de tournée*) charged to the account of the Department are fixed in each Department by the general council, and may not be less than 500 francs. Certain Departments give 1,800 or 2,000 francs.

The duties of professor comprise: (1) Agricultural instruction at the primary normal school, and, if necessary, in the other establishments of public instruction. The pupils of the second and third years receive two lessons a week, completed by a practical exercise and an agricultural excursion; (2) Agricultural lectures throughout the country, at least twenty-six a year; (3) Work or missions which may be imposed upon him by the prefect of the Department or the minister of agriculture. He must also furnish all instruction pertinent to the agriculture of the Department. Every professor who accepts an election in the Department in which he is appointed is considered as having resigned his office.

AGRICULTURAL INSTRUCTION IN CONNECTION WITH GENERAL OR UNIVERSITY INSTRUCTION.

Among the establishments at Paris for advanced education the Museum of Natural History and the Conservatoire des Arts et Métiers possess professorships of agriculture.

Museum of Natural History.—At present there are four professorships:

(1) Of culture. The lectures in the ampitheatre are completed by practical demonstration. The subjects treated of were, in 1887, "Various diseases of vegetables;" in 1888, "Vegetables cultivated in the hot regions of the globe, especially in French colonies;" in 1889, "Modifications undergone by plants under culture."

(2) Of vegetable physics. The creation of this professorship dates back to 1857. The course comprises a study of the conditions which determine, favor, and regulate the production of plants, the use of chemical fertilizers, and the production of green fertilizers.

(3) Of vegetable physiology applied to agriculture. The creation of this professorship dates from 1880, and the instruction occupies three years: first year, Vegetable physiology, properly so-called; second year, Agricultural chemistry; third year, Study of the plants of field culture in the northern region of France.

(4) Of comparative pathology, created in 1880, the instruction is as yet incomplete. The absence of a laboratory hinders the giving to the study of cattle diseases all the development which it deserves.

Conservatoire des Arts et Métiers.—There are three professorships upon agricultural subjects, viz.:

(1) Of analytic chemistry. The course comprises sixty lessons, and is completed in three years; it consists of mineral analysis, practical application, gas analysis, agricultural chemistry, analysis of soils, nutrition of plants, studies upon fertilizers and improvements therein, rotation, alimentation of cattle, etc.

(2) Of agricultural works and rural engineering, consisting of description and studies of farms, machinery, meteorology and hydrology, subterranean and superficial water works, theory of drainage, works of defense and reconstruction of lands, theory and practice of irrigation, road making in cities and pisciculture.

(3) Of agriculture. The lectures consist of agricultural subjects, varying yearly, of which a few are here given: Relation between cattle and vegetable production; Agriculture from a scientific and industrial standpoint; Comparison between the agriculture of France and that of England, the United States, Russia, and Algeria in 1884; Agricultural improvement as affecting the landholder, farmer, and laborer; the problem of agriculture in relation to new economic expedients; Natural and economic agriculture; Intensive culture.

The audience at these lectures varies from year to year; in 1887 it averaged 160; in 1889 only 125 were present at each lecture.

Certain of the professors of chemistry, in various faculties, have introduced agricultural chemistry into their courses with marked success.

At Rennes the late M. Malaguti has left several widely known elementary treatises and has been instrumental in inducing the Breton farmer to adopt the use of fossil phosphates. The present incumbent of the chair at Rennes, M. LeChartier, has devoted himself to improvements in the manufacture of cider, an extensive industry in Brittany.

At Caen, M. Isidore Pierre has published many important memoirs, his researches upon wheat and colza being especially noted.

At Nancy, M. Louis Grandeau has created a very famous agronomic station and has published largely. I had the pleasure of making the acquaintance of this genial gentleman, to whom I am under many obligations, and who in various editorial and official capacities did so much for agriculture at the Exposition and showed such an appreciation of our own exhibit.

At Lyons, M. Raulin, pupil of Pasteur, teaches agricultural chemistry and controls an experiment field. His principal publication has been upon cryptogams.

At Bordeaux, M. Gayon has made many researches upon fermentations occurring in sugars, arable land, and manure.

At Marseilles, M. Marion has studied the Grape Phylloxera, and has strongly advocated the use of bisulphide of carbon.

At Montpellier, the late J. E. Planchon, renowned for his botanical work and for his discoveries in relation to the Phylloxera and his studies of American vines, was a professor.

In fact the aid given to agriculture by such professors has been of inestimable service, and might be made of even greater service had they at their disposal better facilities, such as experiment fields, etc.

PRIMARY INSTRUCTION.

The statute of June 16, 1879 (article 10), rendered agricultural instruction obligatory in the normal and primary schools. Children are now examined in lessons given them upon agricultural questions and it is recognized that this instruction should be directed not to the memory but to the intelligence of the pupil, and should train him to rational observation of all he sees. It should introduce experimental methods into the primary school and establish in the infant mind the fundamental idea upon which modern science is based, at the same time disabusing it of the notion that all intelligent and lucrative work is to be found in cities alone.

The departmental professors are charged with the agricultural instruction in the normal schools, their competency being guaranteed by the numerous tests which they have undergone in their competition for appointment.

The gardens of the normal schools allow instruction in practical horticulture and arboriculture.

The Superior Primary School has for its special character that the instruction there given, while still remaining primary, must be professional or technical, and is given to pupils of from 12 to 16 years of age. In its professional part it is adapted to local necessities and circumstances, and according to conditions, to prepare pupils for agriculture as well as for commerce or for industry.

Each week throughout the year the pupils of the superior school at Dourdan (Seine-et-Oise) have two hours of their instruction devoted to agriculture.

Agricultural instruction is not generally given in lyceums and colleges; yet a certain number of such institutions have created courses in agriculture. In general such courses, in large towns, are entrusted to the departmental professors, and the instruction which they give is analogous to that given at the normal schools for instructors.

Sometimes, as at Civray (Vienne), where there is no resident departmental professor, a special professor of agriculture has been appointed. The incumbent is charged, besides his regular duties as professor, with a course for adults, held in the town during the winter, or upon Sundays during summer in a rural commune. At the colleges at Riom (Puy-de-Dome) and at Mure (Isère), as at Civray, agricultural instruction is given by a special professor.

Free agricultural School at Beauvais.—The *Frères de la Doctrine Chrétienne* have annexed to their boarding school at Beauvais a school of agriculture which they call the *Institut Agricole de Beauvais.* Instruction is there given by both religious and lay professors, and comprises: (1) Agriculture and rural economy. (2) Agricultural bookkeeping. (3) Arboriculture. (4) Rural engineering. (5) Rural law. (6) Applied zoölogy, zoötechny, and entomology. (7) Physics, chemistry, and geology applied to agriculture. (8) Botany. The course of study occupies three years, and the fees for tuition, with board, are 1,300 francs per annum. The experiment field attached to the school contains 100 hectares of arable land and 30 of natural prairie.

Primary and professional Schools of Agriculture at Sartilly (Manche).—This was instituted by ministerial decree, July 16, 1887, and is a true practical school for small cultivation, *i. e.*, such cultivation as is carried on in the Avranchin and Mortain districts, and in a large part of the Arrondissements of Coutances and Saint Lô, or, in other words, in the larger half of the Départment de la Manche, Normandy.

It is to M. Tisserand that France owes this creation, which corresponds to the interests of the region. The school is annexed to the communal school of Sartilly, yet the two establishments are entirely distinct, each disposing of its own premises and personnel under the authority of the same director.

The principal buildings (cowhouse, dairy, stable, etc.), of which models were shown at the Exposition, are constructed after a plan given by M. Tisserand and answer perfectly for their uses. The experimental ground contains about seven hectares, and supports two working horses, four milch cows, and several head of sheep.

The pupils, numbering twenty-three, belong to families of small farmers in the neighborhood. The greater part of them are very intelligent and profit largely by the instruction given them. They are all obliged to return to their families in order to cultivate their paternal acres. Several families make real sacrifices to maintain their sons at the schools, and unfortunately aid can not be given, as the scholarships allotted to the school are extremely limited.

FORESTRY INSTRUCTION.

Forestry School at Nancy.—This school was created by a decree of August 28, 1824. In 1840 an ordinance ruled that there should be formed each year at Paris a jury charged with pronouncing upon the admission to the Forestry School of candidates examined in the Kingdom. On April 2, 1875, a decree was issued relative to the military organization of the Forestry Corps.

A decree of November 3, 1880, gave as personnel of administration to the school one director; one subdirector; one inspector of studies; one financial agent; adjutants of surveillance.

The personnel of instruction comprises one professor of forest economy, one professor of natural history, one professor of legislation, one professor of applied mathematics, one professor of agriculture, one professor of military art, one professor of the German language, two lecturers.

The establishment, of a value of 700,000 to 800,000 francs, at present occupies a surface of 13,305 square meters, of which 8,647 square meters are a botanical garden, 1,872 are interior courts, and 2,984 are buildings. The scientific collections of the school are especially remarkable for native and acclimatized exotic woods and woods from the English Indies and French colonies.

The instruction given at the school is both theoretical and practical. It continues for two years. For six and one-half months there are courses and for three and one-half months there are practical exercises. During the season of courses one day per week is devoted to practical work. During the summer season the pupils visit the principal forest regions in order to practice works in forest management, construction, topography, and replanting.

In addition to the Government pupils, the school admits free French and foreign pupils.

Government pupils are lodged at the school, take their meals in the town, and enjoy certain liberties similar to those of the office pupils of the School of Application at Fontainebleau.

A decree of January 9, 1888, constituted the National Agronomic Institute, which was regarded as a polytechnic school of natural sciences, as the institute where the pupils of the foresty school should receive the first degree of instruction. By this decree, all pupils from 1889 must be recruited under the same conditions as those under which students from the Polytechnic school are recruited for public service.

The establishment at Nancy will thus become a school of application for forestry, and will only receive twelve pupils a year. The instruction, disembarrassed of the preliminaries already received at the National Agronomic Institute, can therefore be devoted to the study of the scientific and economical managements of forests, viz: (1) Forestry science, with application of natural sciences, (forestry, arboriculture, sylviculture, fruit economy, dendronometry, technology, forestry meteorology, estimations concerning forests, etc.); (2) Judiciary science applied to civil and forestry laws, to the chase, to reforestizing, and to the giving of value to uncultivated lands; (3) Administrative sciences applied to the management of a *chef de cantonnement;* (4) Mathematical sciences applied to topography, leveling, construction of maps and charts, buildings, bridges, sawmills, or the regulation of torrents.

The pupils pay a fee of 1,500 francs, with an initiation fee of 1,050 francs for expenses of equipment and purchase of instruments. Four scholarships have also been instituted.

For thirteen years (1873–1886) the school furnished to the English Indies their best forestry service.

By virtue of an agreement concluded with Belgium in 1876, the school furnishes professional instruction to Belgian aspirants in forestry, recruited from the agricultural schools at Gembloux and Lourain.

A decree of July 9, 1889, nominated a commission charged with harmonizing and simplifying programmes of study according to a new mode of recruiting.

Experiment Station instituted at the National Forestry School.—This station, annexed to the school in April, 1882, placed under the care of the director of the school, was created by a decree of February 27, 1882, and only consists of an agent, of the grade of adjoint inspector, with one brigadier. Its experiment field contains 2,536 hectares of forest. Two decrees (October 15, 1885, and November 12, 1887) added to its domain 106 hectares of pine woods situated in the Vosges. A second agent of the rank of garde-general was added to the director by a decree of June 24, 1886. This station has to study by experiment any forestry questions which are as yet obscure or doubtful, and also to come to the aid of the theoretical instruction of the school by allowing the professors to give the pupils practical lessons in the forests of the experimental fields.

The four sorts of work devolving upon the personnel of the station are as follows: (1) Technical management of forests, or of that portion of the forests composing the special experiment field of the establishment; (2) Technical management of the forest nursery at Bellefontaine; (3) Observations of comparative meteorology, agricultural and for forestry; (4) Forestry researches, properly so called.

Practical School of Sylviculture.—A decree of January 14, 1888, instituted upon the domain of Barres-Vilmorin, in the commune of Nogent-sur-Vernisson (Loiret), a practical school of sylviculture having for its object to form private guards, agricultural and forestry keepers, and to give good professional instruction to young men who wish to follow this sort of employment.

The school receives internes and demi-pensioners. The price of board is 600 francs per annum and that of half-board 300 francs, payable in advance by tenths. Besides the price of board the pupils must at their entrance pay a sum of 100 francs as a guaranty for the payment of their uniforms and the replacing or mending of objects broken.

The duration of the course is two years, the course commencing October 15 and ending August 15. The instruction is both theoretical and practical.

The practical instruction consists of the work of cultivation upon the domain and in its nurseries, laboratory courses, exercises in topography, and also excursions in the forest of Montargis, where the pupils take part in all the operations relative to wood-cutting.

The theoretical instruction comprises: (1) General agriculture; (2) Elements of sylviculture: management of wood, etc.; summary idea of management especially of underwood; (3) Elements of forestry law and ideas upon the administrative organization of France; laws of the chase; conduct of lawsuits and prosecutions; (4) Elements of forestry botany; (5) Arboriculture and viticulture; (6) History and geography; (7) Arithmetic and elementary geometry; (8) Topography and linear drawing; (9) French language, writing reports; (10) Physics, meteorology, and chemistry applied to agriculture; (11) Agricultural book-keeping; (12) Military exercise.

VETERINARY INSTRUCTION.

Bourgelat was the true founder of veterinary schools. He was born at Lyons in 1712, and if he was not the first who wrote upon veterinary medicine he has the distinction of having conceived the idea of regularly teaching it and of giving it all desirable extension. In 1740 he obtained the position of *equerry*, and also a commission for exercising this office, in which he established himself in August of that year, the consulate of the city of Lyons allowing him a salary of 1,000 livres for instructing young men in the art of equitation and for giving other necessary instruction. In the same year, 1740, he published a treatise upon cavalry, and ten years later he published his "Elements d'Hippiatrique," or "New Principles of the Knowledge and the Medicine of Horses."

From 1740 to 1761 Bourgelat continually cherished the hope of founding a school where instruction might be given in anatomy, therapeutics and farriery to young men who might, by their profession, be called upon to care for animals.

Bertin, comptroller of finances, wished to place Bourgelat at the head of a haras in Lorraine, but abandoned that idea when he obtained from Louis XV authority and funds for opening a veterinary school at Lyons, in 1761. By this authority a sum of 678,000 francs was accorded to Bourgelat as an estimate of the expenses which the establishment and instruction of such a school might require.

During the Revolution all such schools were under the direction of the "Committee of Agriculture and Arts." The law of 1819 placed them under that of the Minister of the Interior until 1828, when they become attached to the Ministry of Commerce, and finally, after various changes, were permanently attached to the Ministry of Agriculture in 1882.

The course of study at the veterinary schools is as follows: (1) Anatomy of domestic animals, general and external anatomy of the horse. (2) Physiology of domestic animals, teratology, general therapeutics. (3) Physics, meteorology, chemistry, pharmacy, toxicology. (4) Pathology of contagious diseases, sanitary police,

inspection of meats and of abattoirs, legal medicine, and veterinary jurisprudence. (5) General and medical pathology, pathologic anatomy, and clinics. (6) Surgical pathology, manual operations, obstetrics, farriery, and clinics. (7) Natural history (zoölogy, botany, geology), materia medica. (8) Hygiene and zoötechny. (9) French literature, French and German languages.

These schools receive both boarding pupils, demi-pensioners, and day pupils. The boarders pay 600 francs for the school year, the others paying 400 and 200, respectively. In addition each pupil is required to pay 30 francs as an indemnity for objects broken, etc. Bonuses are instituted in favor of those pupils whose parents are poor. Foreign pupils are admitted as freely as French. Admission is procured only after an examination, which, however, may be dispensed with by candidates holding degrees of bachelor of arts or of sciences, or a diploma of special secondary instruction, or diplomas of the National Agronomic Institute, or of any one of the national schools of agriculture. Candidates must be between the ages of 17 and 25, and must show (as is usual throughout France in all similar matters) their *acte de naissance*, and certificates of vaccination and of good moral character. Any candidate failing in examination for entrance may not be examined again for a full year.

The veterinary School at Lyons.—As we have seen, this school was founded in 1761 by Bourgelat, in connection with the riding school at Lyons. It did not prosper until, in June, 1764, Louis XV decided that it should thenceforth be called the Royal Veterinary School, and a regular subsidy, derived from the earnings of the fiacres of Lyons, was also allotted to it. After various vicissitudes the school became a national establishment in April, 1793. Twenty bourses were created, which were suppressed in 1825, but reëstablished in 1876.

Since 1871 over 130,000 francs have been devoted by the ministry of agriculture to the improvement of this school. The duration of the course is four years. The number of professors was at first two, then four in 1790, then five from 1796 to 1866, and eight since 1881. From 1813 to 1825 the school gave the diploma of *Maréchal Vétérinaire*, but from that time it gave that of veterinary surgeon. In 1811 the text of the diploma was so modified as to give it a character analogous to those given by the ministry of public instruction.

Veterinary School at Alfort.—On June 1, 1764, Bourgelat was appointed director and inspector general of the Royal Veterinary School at Lyons, and of all similar schools then established or to be established in the kingdom. At that time the Château at Alfort, close by Paris, and belonging to Baron Bornier, was purchased by the crown to found a veterinary school. Bourgelat was called upon to take charge of the installation of this new school, and great prodigality was shown in its furnishing, so that by 1787 its expenses had

caused a deficit of 374,000 francs. The cavalry commission was required to support 20 pupils, according to a decree of 1793, and in 1825 an ordinance sent all military scholarships there.

School of the Haras.—This school, reëstablished at Pin (Orne) by a decree dated May 29, 1874, is placed by the same decree under the command of the director of the Stallion Dépôt at Pin.

The instruction is divided into eight classes, viz: (1) Hippic Science; (2) Administration and Care of Establishments, Administrative Account-keeping; (3) Theory and Practice of Equitation, Harnessing and Horse-training; (4) Zoötechny, Anatomy, Physiology, Hygiene, and Externals of the Horse; (5) Pathology and Farriery; (6) Vegetable Physiology, Theoretical and Practical Agriculture, Forage Botany; (7) Drawing; (8) English and German Languages.

The number of pupils admitted each year is nine at the most; they must be between the ages of 18 and 24, and are only admitted by examination. The instruction is gratuitous and the course of study occupies two years, examinations being held each half year. Pupils who receive diplomas are given positions in the establishments of the Haras Administration as *surveillants stagiaires*, or tyros, without pay. They are made full surveillants according to rank, as vacancies occur. Students who have received diplomas from the Agronomic Institute or from the Veterinary school are admitted to this school without examination.

PART II.—FOREIGN COUNTRIES.

AUSTRIA.

An Institute of Sericiculture was founded at Görz or Gorizia in January, 1869, its objects, as stated in its programme, being: (1) To establish the essential conditions of health of silkworms and those of improvement of yields; (2) to seek the best method of procuring healthy eggs in sufficient quantities; (3) to investigate the causes of prevailing diseases among silkworms; (4) to test new species of silkworms; (5) to disseminate practical instruction and advice. Prof. Haberlandt was director of the station from 1869 to 1872, and was succeeded by Prof. Bolle.

The Institute receives pupils of over 20 years of age who have already had some instruction in sericiculture. The course of instruction occupies only five or six weeks, and certificates of proficiency are given after a final examination. About thirty pupils are received annually, mostly coming from the Austrian shores of the Adriatic.

From 1869 to 1889 in the Austrian silk-raising regions the production of cocoons increased from 80,000 to 650,000 kilograms, while in Hungary, where it was but 7,500 kilograms in 1879, it had increased to 700,000 in 1889.

There are two brewing schools, one at Mödling, near Vienna, and one at Prague, both founded in 1869. There is also a laboratory for brewing investigations at Vienna, created in 1887. The school at Mödling is a Government one, the other two being private institutions. They are all well fitted out, and are fully equal to the best similar institutions in Germany.

The same has been done for the sugar industry, one school having been founded at Vienna in 1870, and one at Prague in 1875.

There is also a distillery laboratory at Atzgersdorf, near Vienna, and a school of distillery at Prague. At the latter the instruction given is upon the formation of alcohol, the study of fermentation, mechanics, the study of steam boilers and their construction and installation, etc., while practical instruction is given in a large private distillery through the courtesy of the proprietor Instruction generally lasts four months and costs only 80 florins ($40). A diploma is given after examination.

Nomadic instruction in apiculture is customary in Austria. And to the Superior Agricultural School at Vienna there is attached a forestry institute.

HUNGARY.*

This country claims to be the birthplace of agricultural instruction, a school having been founded there as early as 1786. This was followed in 1797 by a famous school, the "Georgicon," and in 1818 by the institute at Magyar-Ovár. In the first and last of these three schools the instruction was rather empirical in its nature, but in the Georgicon, at Keszthely, great care was taken. The professors were sent to travel in foreign lands to keep pace with foreign progress, and the best methods of instruction were constantly sought. In 1848 the war broke up the Georgicon, its students all departing for the field; the other two schools continued their courses, however, but in the German language, and there was no school giving agricultural instruction in the Hungarian tongue until 1865, when an institute was founded at Keszthely, the locality of the old Georgicon. Similar establishments were created at Debreczin in 1867, and at Kolozs-Monostor in 1868, and finally in 1875 a superior establishment was formed at Kassa.

Primary agricultural schools were also formed from 1883 to 1888, and there is now a sufficiency of schools of all grades to meet the agricultural requirements of the country. They are under the direction of the State which takes solicitous care of them, though it is curious that no exhibit of their work was to be seen at the Exposition.

* For this review of agricultural instruction in Hungary I am almost entirely indebted to a paper read before the agricultural Congress at Paris, 1889, by Bela Tormay.

The Academy at Magyar-Ovár.—This was founded as an institute in 1818, and has since been promoted to the rank of an academy. It is purely scientific in its instruction and has a course of study occupying two years. Pupils are admitted upon certificates of capacity and after they have passed a year upon a preparatory farm. Since 1818 this institution has received 4,383 pupils. The present average is from 120 to 160 yearly.

The personnel of instruction comprises—a director, who is also professor; seven ordinary professors, and two assistants; an inspector and assistant inspector of agriculture; a chief gardener, and an economist.

All the usual branches of agriculture are taught, and various excursions are made in the country and even abroad.

In connection with the academy there are several experiment stations as follows: (1) For the study and trial of machines, (2) a chemical laboratory, (3) a station for the testing and study of seeds and cereals, (4) a demonstration field, (5) a meteorological station making observations three times a day and telegraphing them to the central institute at Buda-Pesth.

The academy also possesses a domain of over 180 hectares, almost the whole of which is under cultivation, and also 13 horses, 16 oxen, 83 cows and bulls, 57 swine, and 127 sheep. The *arboretum* contains 700 young trees. There is a special garden for practical instruction which is provided with a special system of irrigation. The annual expenses of the school are about 60,000 florins (about $24,000), its receipts being 29,000 florins.*

The four remaining institutions were all reorganized in 1874, in such a way as to devote more time to practical instruction. The pupils were allowed to pass most of their time in actual cultivation and had only two theoretical lessons a day. In 1888 a further change was made; the instruction in the four schools was made uniform, and more time in proportion was afforded for theoretical instruction. The course of instruction is three years and the expense to the students is only 40 florins a year, except at Kolozs-Monostor where it is only 20 florins a year. These schools may each be more fully described in detail:

Keszthely.—This school in the twenty-three years from 1865 to 1888 has been attended by 1,112 pupils. The personnel of instruction comprises: One director, who is also professor; five ordinary professors, with one assistant professor and one tutor; one instructor of practice for the first year's class; one chief gardener, one cashier, etc.

For the pupils of the second and third years excursions are organized to farms and factories. A library of about 6,700 volumes and pamphlets, valued at over 15,000 florins is connected with the school, and the apparatus, etc., used is valued at 28,000 florins. The grounds

* The Austrian and Hungarian florin is equivalent to about 40 cents.

of the institute occupy 181.70 hectares, and there are 10 draft-horses, 16 oxen, 7 bulls, 33 cows and heifers, 169 sheep and 53 swine.

There is also a station for chemical research, and an apicultural station, experiment field, meteorological observatory, grain testing station, etc. The budget for 1889 consists of 39,760 florins expenses, and 16,430 florins receipts. There are at the institute six scholarships of 150 florins each given by the state, together with five private scholarships.

Debreczin.—This school was opened in 1867, and in nineteen years (1868–1887) had received 1,246 pupils. The personnel of instruction comprises: One director, who is also professor; five ordinary and two extraordinary professors, with one assistant professor and one secretary; one agricultural manager or steward with three assistants, and one gardener.

There is a library of 2,420 volumes, valued at 12,070 florins while the reading room subscribes to 50 periodical publications. The value of the apparatus of the school is over 28,000 florins. The domain of the institute contains 345 hectares and consists of farmyard, courts, garden, arboricultural school, trial fields, plantations, artificial prairies, pastures, etc. There are 29 horses, 24 oxen, 110 head of reproductive cattle including 8 bulls, and also 330 sheep and 160 swine. There is a large plantation of osiers, and a seed-testing station, while the meteorological station corresponds by telegraph with Buda-Pesth, Vienna, Paris, and St. Petersburg. The expenses for 1889 were 21,180 florins and the receipts only 2,400 florins. There are six scholarships of 150 florins each.

Kolozs-Monostor.—This institute being near Kolozs-vár, the pupils are enabled to attend the university of that town at the same time. From 1869 to 1887 there were 1,435 pupils. The personnel of instruction comprises: One director, who is also professor; five ordinary professors, and three extraordinary, or occasional professors; economist, steward, chief gardener and assistant.

The library contains 2,172 volumes, valued at 12,361 florins and 42 periodicals are subscribed for. The value of apparatus is 24,000 florins. The domain contains 427 hectares and comprises 9 horses, 32 oxen, 62 cows and calves, and 5 bulls, besides 458 sheep, and 107 swine.

In the vineyard are cultivated 7 varieties of wine grapes, besides 40 varieties of vine upon the espalier. There is an experiment field and also a hospital for animals, where in 1886–'87 some 150 animals were treated, some belonging to private persons. The meteorological station is in communication with Buda-Pesth. Sericiculture, apiculture, and pisciculture are taught at the Institute, and each year excursions are organized for the pupils. In 1889 the total expenses were 47,940 florins.

Kassa.—The personnel of instruction consists of 1 director who

is also professor, 4 ordinary professors, 2 adjunct professors, one of whom is also treasurer and secretary, and 1 supplementary professor, 1 chief gardener, 1 steward, 3 aids.

The domain contains 323 hectares, and the farm stock consists of 17 horses, 2 asses, 18 oxen, 3 bulls, 57 cows and calves, 188 sheep, and 58 swine. In the orchard there are 244 sorts of apple, 280 of pear, 50 of plum, 45 of apricot trees, 30 of nut trees, and 60 of various berry-producing plants. The vineyard comprises 112 sorts of grapes, mostly dessert grapes. There is a special establishment for instruction in cheese making, while there is also a distillery connected with the school, where distillation is performed with potatoes, topinambours, maize, and barley, 64,497 liters of alcohol having been produced in 1886–'87.

The budget for 1889 shows: expenses, 73,750 florins; receipts, 48,700 florins. There are six scholarships of 150 florins each, besides many private ones.

Primary agricultural Schools in Hungary.—These have been created without any regular system and according to the wishes of their founders alone, and it is only lately that the ministry of agriculture has sought to systematize them. They are divided into two categories, those maintained by the state and those still controlled by private persons or corporations, which latter are partly subsidized by the State in certain cases. The State schools are of two kinds, those where practical instruction is principally given, and those where theoretical instruction is mingled with practice. One or two schools may be mentioned in detail.

The School at Ada.—This is a State school, where the instruction is mainly practical. The personnel consists of a director who is at the same time the schoolmaster, with an assistant director, a gardener and assistant gardener. Pupils must be 17 years of age and of good health and character, and able to read and write, but no other examination is necessary. The yearly support of the pupil costs only 150 florins, which amount may be reduced by the pupil's own labor. There are a certain number of scholarships for poor pupils. Boarding and day pupils are received. In 1887–'88 the total number of pupils was 33. The domain cultivated at the school consists of nearly 78 hectares, and the live stock consists of 4 horses, 15 colts, 8 oxen, 20 head of breeding cattle, 29 swine, but no sheep. The budget for 1889 provides for 11,280 florins expenses ($5,640), and 7,850 florins receipts ($3,925).

There are six other State primary schools, two of which are purely practical and four of which combine theory with practice. These schools cultivate 3,480 *jochs* (2,001 hectares; a *joch* equals $57\frac{1}{2}$ *ares* or 1.42 acres) and possess 1,245 farm animals of all sorts. One of these schools, at Debreczin, is connected with the Agronomic Institute there.

The School at Istvan-Telek may be mentioned as an example of one of these schools not directly under State patronage. It is maintained by the Hungarian National Agricultural Society, but has an annual subsidy from the ministry of Agriculture of 1,650 florins ($825), which will pay for the board of 16 pupils. The personnel of instruction comprises a director, an assistant professor, and a gardener. The course of study occupies three years. Pupils must be 15 years of age and must have completed their studies at one of the primary schools. The cost of board and tuition is 150 florins ($75) yearly, except for the 16 pupils aided by the State subsidy. In 1888–'89 the number of pupils was 30. The school cultivates about 75 hectares, of which part is devoted to arboriculture and part to researches upon phylloxera. There are 9 horses and 20 cows at the school. There are four or five other schools of similar nature, two of which are in Transylvania.

The total number of pupils in 1887–'88 was 732 (including 12 foreigners) at the State normal schools and institutes, and 75 at the private schools. These schools have another object than instruction in agriculture, and that is to furnish to farmers and stock-raisers animals of pure blood for reproduction and good seeds at fair prices. In 1888, these schools and institutes furnished to the country 554 head of breeding animals; 71,800 kilos of seeds of all sorts; 12,096 young fruit trees; 12,019 young ornamental trees; 13,285 grapevine slips for grafting, etc.

There also exists in Hungary a system of agricultural instruction similar to that given in the primary and normal schools in France. Such a course is given in the normal school at Debreczin, where general agriculture, horticulture and viticulture are taught, and this course is found particularly useful, since schoolmasters who have followed it afterwards become authorities in agriculture throughout the country.

A special course is carried on in the distillery school at Kassa, both for proprietors of distilleries and for their workmen. Also at Kassa there is a separate course of mechanics and of the use of machinery, which is attended by most of the pupils of the institute. At Kolozs-Monostor there is a course of horticulture for schoolmasters.

Evening courses are held in towns where there are agricultural institutes or schools, and are generally attended by the neighboring farmers. Winter courses have recently been organized in these same towns and have spread to neighboring towns. Nomadic courses have also been instituted, especially for special subjects, such as the cultivation of flax, hemp, or tobacco. The last mentioned is especially appreciated at the ministry of Agriculture. The ministry also encourages the propagation of special works upon agriculture and subsidizes the societies which publish such books, some being printed and distributed gratuitously by the ministry itself.

The veterinary School at Buda-Pesth was founded in 1786, and later reorganized in such a way as not only to form veterinary surgeons, but also to form specialists for the sanitary police of the rural districts and for the raising of stock. Four new professorships were created. The course of instruction was extended to three years instead of two only, and instruction was given in the Hungarian language alone, and not partly in German, as formerly. Finally, a large and convenient building was erected upon ample grounds, with smaller buildings for laboratory, hospitals and halls, and for collections, and a sufficient subsidy and personnel were accorded by the State. The results obtained have justified the measures adopted, and the veterinary surgeons graduating from the school render important service to the agriculture of the country.

The course of instruction lasts three years, and pupils who have passed the final examinations are received into the royal haras upon a salary. The extension of the course to four years is under consideration. The pupils are instructed free of charge and only pay a fee for examination. The personnel of instruction comprises: One director, six special professors and two assistant professors, one tutor and six assistants, three pupils who have terminated their studies and who receive salaries.

In addition there are attached to the school one mechanician, three special domestics, ten other domestics who have care of the animals, a farrier, and three aids.

The number of pupils in 1888 was 274 of all grades. In the hospitals of the school 4,265 animals were treated during the same year.

Connected with the school is a course for instruction in horse-shoeing and horseshoe-making, 718 persons having availed themselves of this course, of whom 480 have received certificates of proficiency.

BELGIUM.

This country, which was for centuries the leading agricultural country of the world, has at last felt the effect of the great agricultural crisis, and has been stimulated thereby to effort in the direction of agronomic instruction.

This instruction is of two sorts, official and private, and both these range from primary to superior instruction. Common primary agricultural schools exist all over the country, many of them receiving Government aid, the instruction being gratuitous in all of them. The primary schools are intended for the sons of farmers who are unable to give them complete instruction. All branches of ordinary education are taught at these schools with a general bearing toward agriculture, and elementary courses in agronomy, zoötechny, arboriculture, and applied chemistry are also given. In the intermediate schools agronomic studies are proportionate to other branches and efficient agronomic subengineers are trained, who

after a novitiate of one or two years are able to direct a farm. The school at Mont-sur-Marchiennes is of this description.

Courses of lectures upon agronomic subjects are given in twenty-seven of the intermediate schools of the State.

Superior instruction is represented by the State Agricultural Institute at Gembloux and by a superior school of agriculture attached to the university at Louvain.

Special instruction is represented by horticultural schools at Ghent, Vilvorde, and Carlsbourg, and by a veterinary school at Cureghem.

Practical instruction is also given. Agronomic lectures have been given for many years, but have greatly increased since the establishment of a State agronomic corps. The members of this corps, living as they do among the rural population, are able to render important service.

Agricultural courses for adults have lately been organized in the more important communes and give instruction adapted to the needs of their respective regions. Lectures upon horticulture have also been successful.

In 1888 a special course upon brewing was instituted at Louvain, and a brewing school was opened at Ghent, after the model of similar schools in Germany and Austria.

GERMANY.

Beyond two or three isolated contributors from Alsace there were no exhibits from Germany, though in few other counties are there to be found more effectual methods of agricultural instruction and experiment. At the international congress Professor M. Keyser read, however, an interesting paper on some phases of German instruction which are sufficiently characteristic to justify the following summary.

Germany, one of the largest beer-producing and beer-consuming countries, has taken active part in the development of this industry and in instruction in connection therewith. The first lectures upon brewing were given at Schleisheim about 1824, and from these the first brewing school arose, which, having been transferred to Weihenstephan, is now one of the best of such schools.

Since 1860 several similar schools have been formed—one at Worms in 1860, and another in the same town in 1865, one at Augsburg in 1869, and finally one at Munich in 1882.

These schools all have the same object, which is to afford theoretic instruction for brewers and to perfect chemical specialists in this art. The schools are all founded by private enterprise except that at Weihenstephan, which belongs to the State. The instruction is both theoretical and practical, but generally lasts for only three or four months.

Taking the State school as a model, the instruction comprises mathematics, applied geometry, mechanics, physics, general chemistry, brewing (properly so called), study of fermentation, special study of constituents employed, botany, construction and materials of breweries, administration, accounts, legislation, hippology, and manipulation. Practice in brewing is also given, together with lectures and excursions. In addition pupils may follow the various operations of brewing from first to last, either in the great Bavarian State brewery or at small experimental breweries attached to the various schools.

There are generally seven or eight professors at each school, while the number of pupils varies from fifty to one hundred. Examinations are passed before a board composed of professors and brewers. At Worms the examination takes the form of the complete brewing of a beer, the process, degree of concentration, and color being indicated. For admission pupils must be 18 years of age and must have all the instruction required for German military service.

Brewing laboratories were instituted at Munich and at Weihenstephan in 1866. These have a two-fold object, first to perfect brewing and malting by scientific research and to further the interests of brewers by the analysis of materials and of products and by the trial of new apparatus; secondly, to give counsel in the case of accidents and to train pupils by teaching them rational methods and explaining the philosophy of different operations.

There are also laboratories at Berlin, Nuremberg, and Hohenheim. That at Berlin was created by a society in 1882, and in 1888 it was converted into a laboratory for instruction, where courses of three months' duration are given upon malting and other branches. The ministry of agriculture has allowed a subvention of 225,000 marks ($56,250) for the installation of a model brewery at this school. The fermentation laboratory at Hohenheim was created in 1889 and is furnished with all apparatus necessary for making investigations in brewing and distillation. Materials are analyzed there, and any brewer or distiller of Wurtemburg may come there to analyze his material with the aid of the director.

Schools for the Sugar Industry.—There are two of these in Germany: one at Brunswick, dating from 1876, the other at Magdeburg. Both were founded by private enterprise.

The school at Brunswick has for its object the training of sugar manufacturers by means of appropriate instruction and practical manipulation. The subjects taught are physics, general and analytical chemistry, sugar-making, the production of sugar beets, the study of fertilizers, applied geometry, arithmetic, the setting up of steam boilers, the construction and conduct of sugar refineries, etc.

The instruction lasts for four months and commences at the end of the sugar season, so that manufacturers may avail themselves of it. A certificate of proficiency is given.

The sugar laboratory at Berlin is in reality a school and is carried on by a society. It makes scientific investigations and gives theoretical and practical instruction. The conditions for admission are the instruction required for military service and six months' service in a sugar factory or refinery. The instruction comprises lectures in general chemistry and in sugar technology and practical use of apparatus. The State furnishes the buildings and furniture, while the society furnishes apparatus, material, and gas.

Distilling and Starch-making.—Instruction in these branches is given in special laboratories. The distillation laboratory at Berlin was founded in 1874 by the association of distillers of the Empire. The State furnishes the buildings. Lectures are given upon starch-making as well as upon distilling, fermentation, and yeast-making. The same association has also created a similar laboratory at Insterburg, in eastern Prussia. Those who attend the lectures at these schools also visit distilleries and starch factories and thus get practical instruction.

GREAT BRITAIN.

In England the system is similar to that in Scotland, except that agricultural courses are not generally given at the universities. At Oxford, however, there is a special but limited course in rural economy. Prof. Th. Jamieson presented an excellent statement of the present status of agricultural instruction in England, and to this I am indebted for the chief facts. There are in England three agricultural colleges, though none of them are as extensive as some of ours. They are at Cirencester, Downton, and Aspatria. At Cirencester, which is the oldest and most complete, the pupils are mostly sons of landowners, and there are laboratories and experiment fields. At the other two colleges the pupils are rather sons of farmers. Downton is the larger of the two and has laboratories and fields as at Cirencester, which do not exist at Aspatria.

Establishments for research exist to the number of five: one of these is that of the Royal Agricultural Society at Woburn, and of the others the celebrated experiment station at Rothampstead, established by the private liberality of Sir J. B. Lawes, is the most important. The other three are in Sussex.

Up to the present time (1889) the only aid afforded by the State to agricultural instruction has been in slight subsidies distributed by the Science and Art Department at South Kensington to such common schools in the United Kingdom, 332 in number, as include agronomic subjects in their curriculum. The State also remunerates a professor at London who instructs country teachers in similar branches, and it also gives £150 to the agricultural professor at Edinburg. In 1889 the Government voted £5,000 for the encouragement of agricultural instruction, especially in the matter of dairy work.

In Scotland there are no agricultural institutions, properly so called, but instruction in agriculture is given at the universities of Aberdeen and Edinburg and also at Anderson College, Glasgow. In primary or intermediate schools theoretical and elementary instruction is given under the direction of the Science and Art Department.

At Aberdeen the instruction consists mainly of natural sciences applied to farming, with practical demonstration and visits to the agronomic station. At Edinburg the course is more specialized and there are also separate chemical courses and visits to farms. At Anderson College the course is held in the evening, this being supplemented by visits to farms. At each of the two universities there is one professor, while at Anderson there are two. Pupils are admitted without examination, and are for the most part school teachers or students who are fitting at the universities for teaching in country schools, or again sons of farmers. There are about 50 pupils at each school, and in general they have previously received only the ordinary high school education. Certificates or diplomas are issued by each institution.

In general it may be said that agricultural instruction languishes in Scotland, since farmers do not understand the necessity for it and since the Government does not give it adequate support.

There are three agronomic stations in Scotland, one near Aberdeen and two near Edinburg. There are, however, no laboratories which make public analyses. Agricultural chemists perform analyses privately for varying fees and without concerted method, and there is no regular control or system. Fertilizers are sold on warranty, and here and there associations of farmers are formed to take samples of fertilizers for analysis. There are no experiment fields except at the above three stations.

LUXEMBURG.

A superior school of agriculture containing about 80 pupils is established at Ettelbrück. The instruction given is purely theoretical, except that excursions are made twice a week to the best farms in the neighborhood. The course of study is two years, but the first year being preparatory, advanced pupils are only required to pursue a two-years course.

In 1888 a course of lectures for adults was organized in some of the rural communes. The normal school at Luxemburg has no agronomic instruction, but efforts are now being made to supply the deficiency and also to render agriculture obligatory in primary schools.

ITALY.

The Kingdom hasthree superior agricultural schools, one at Milan, one at Pisa, and one at Naples. Professors in the practical schools

and directors of agronomic instruction in the technical schools are chosen from the graduates of these three institutions.

Each province of Italy possesses its practical school, the oldest of which dates back for ten years only. In these the course of instruction is of three years' duration and each has from 30 to 100 hectares of land. It is found that practical instruction is especially important, as in the technical schools, where agriculture is only taught in theory, many graduates afterwards give up their agricultural career. The establishment of a practical school costs the State about 20,000 francs; the expenses of support of the school are borne by the province or by the cities or by local clubs. The expense to each student is only 150 francs annually.

Italy also has special schools for viticulture and for dairy work, and there are five agronomic stations in different parts of the country.

At Padua there is an experimental *baccological* or sericicultural station, founded in 1871, having for its object the study of the silkworm, its nutrition and diseases, the preparation and dissemination of eggs, the trial of new varieties, and the general supervision over the industry of silk-raising in the Kingdom. An annual credit of 20,000 francs is opened for the station and complete independence is enjoyed. The station has localities for the raising of silkworms, courses of instruction for pupils, laboratories, collections, apparatus for the hibernation of eggs, and a filature.

The normal course of instruction takes place during the spring and is given to men, while a second course has been given in July and August since 1880 for women, and there are about twenty pupils annually in each course. Many of those who receive certificates become raisers of eggs or chiefs of sericicultural observatories; *i. e.*, experimental nurseries dependent upon the station at Padua, and of which there are about sixty in the country. The station publishes annually a large volume of bulletins concerning its work, under the title of *Bolletino Mensile di Bachicoltura.*

In 1878 Italy produced 37,550,000 kilograms of cocoons, while in 1888 the production was 43,899,000 kilograms. The average yield per ounce (27 grams) of eggs rose in these 10 years from 20 to 32.8 kilograms.

PORTUGAL.

The only exhibit from Portugal was a series of valuable Government bulletins or reports by the minister of public works, commerce, and industry, Emygdio Julio Navarro, from which the following facts are drawn: Agricultural instruction in Portugal was by royal decree in 1886 divided into three grades—superior, secondary, and elementary—and appropriate schools have been established for each grade.

Superior agricultural instruction is given at the Institute of Agronomy and Veterinary Science at Lisbon. This was founded in 1864, and was then called the General Institute of Agriculture but was reorganized and renamed by the above decree of 1886.

The institute numbers twenty-one professorships, each having its special course, and is intended to educate its students to become agriculturists, sylviculturists, and veterinary surgeons.

Of the above twenty-one courses five are general, namely, those of (1) physics, meteorology, mineralogy, and geology; (2) general and analytical chemistry; (3) botany and vegetal physiology; (4) zoölogy and exterior of domestic animals; (5) general and special zoötechny and hygiene of cattle. These are attended by the students of all branches, while the other courses, partaking of a more special nature, are followed by those students who are more directly interested in them. Thus candidates for diplomas in agriculture and sylviculture are required to pursue courses, viz: (6) agricultural chemistry, with analyses of earths, plants, and fertilizers; (7) field culture and horticulture; (8) general mechanics, with application to agricultural mechanics, topography; (9) rural construction; agricultural hydraulics; (10) rural and forest economy, administrative legislation, bookkeeping; (11) microscopy, vegetal nosology, entomology; (12) rural and forest technology, analysis of products; (13) sylviculture; (14) viticulture and arboriculture.

Candidates for diplomas as veterinary surgeons omit the above courses (6 to 14 inclusive) and take the following in their place: (15) descriptive anatomy and teratology; (16) histology and comparative physiology of animals; (17) materia medica, pharmacy, toxicology, medical chemistry; (18) general pathology and pathological anatomy; (19) surgery, veterinary obstetrics, surgical clinics; (20) special external and internal pathology; general therapeutics, and medical clinics; (21) veterinary law, epizootics, sanitary police, legal medicine.

Students in agriculture and sylviculture pursue a four years' course, after which the agricultural graduates are required to practice for eight months as apprentices in the practical agricultural schools or at the agronomic stations, while the sylvicultural graduates are required to pursue a similar course in the central forestry district. The course for veterinary instruction occupies five years.

Instruction in these twenty-one courses is both theoretical and practical, the practical lessons being given in the laboratories, cabinets, museums, and other annexes of the Institute or in the fields connected therewith. These annexes are as follows: (1) cabinet of physics and natural history; (2) laboratory of agricultural chemistry; (3) laboratory of microscopy; (4) hall of practical exercises in applied mechanics and topography; (5) museum of plants, seeds, and agricultural and forest products; (6) museum of agricultural engineering; (7) experiment field and garden, garden for veterinary medi-

cines; (8) laboratory for medical chemistry and toxicological analysis; (9) laboratory for bacteriology and histology; (10) cabinet of anatomy and surgery; (11) cabinet of pathology; (12) pharmacy; (13) library; (14) veterinary hospital; (15) veterinary consultation stand; (16) siderotechnic shop; (17) depository for parturient animals.

During the third and fourth years of their course the students of the first two categories visit various factories, etc., such as distilleries, dairies, flour-mills, factories for wine-making, extraction of oils, bread-making, etc., and also gardens, greenhouses, museums, cabinets, and collections, and in addition make scientific excursions to agricultural and forest exploitations.

During his apprenticeship each graduate must prepare a memoir in connection with his specialty, upon the agricultural or forest economy of the region in which he is stationed, and must, upon an appointed day, defend his thesis before a jury of six professors.

The veterinary student, after having completed the fifth year of his course, must present a dissertation upon a special subject, and this dissertation, after having been read by each member of the jury, must be defended by the candidate.

The diplomas which are awarded indicate the courses pursued by the student and his standing upon graduation. In addition to the final examination and the thesis or dissertation there are two examinations a year in each course of study.

Veterinary students trained at foreign schools must pass an examination before a jury of professors in order to practice their profession in Portugal.

Secondary agricultural instruction is given at the Central Practical School of Agriculture, which was founded at Coimbra in 1887. Elementary instruction is also given at the same school.

The secondary instruction is intended to educate pupils to be: (1) agricultural directors, as managers of rural exploitations, or technical agents in the establishments of agricultural arts; (2) forest directors, as managers of forest exploitation, or agents in establishing the arts of forestry or in the industrial utilization of forest products; (3) flock directors, or managers of cattle and sheep, or practical veterinarians.

This secondary instruction occupies four years and comprises the following subjects of study: (1) Portuguese language; (2) French language; (3) arithmetic, geography, and surveying; (4) principles of the natural sciences; (5) studies of the soil, chemistry, natural physics; (6) agricultural machines, topography, rural and hydraulic construction; (7) field and garden cultivation, common diseases of plants; (8) tree and shrub cultivation, and their respective diseases; (9) agricultural arts; (10) forest cultivation; (11) principles of rural economy and administration; (12) study, exploitation and hygiene of domestic animals, (13) organs and functions of animal life; (14) diseases of animals and operations; (15) medicine and sanitary legislation.

Of the various subjects the agricultural directors are required to pursue Nos. 1 to 9, inclusive, and also Nos. 11 and 12. Forest directors pursue Nos. 1 to 6, 8, 10, and 11, while flock directors pursue Nos. 1 to 4 and 11 to 15, inclusive.

The pupils in these several courses are required to spend not more than one hour per day upon theoretical work, and to devote as much time as possible to practical demonstrations and exercises in the field or in laboratories or museums, shops, infirmaries, etc., established for the manipulation of agricultural products or for the study and perfection of domestic animals and their products. Pupils who follow the forest director course are required to practice forestry for three months in designated forests, under the guidance of an instructor.

The elementary instruction given at this school is intended to form: (1) Rural operatives, as bailiffs, farm servants, or practical masters of various branches of agriculture; (2) flock tenders, as shepherds, grooms, farriers, etc. The instruction occupies three years. The theoretical part of this instruction consists of such of the above subjects as will fit the pupils for the rural pursuits most appropriate to their respective regions. The greater part of the instruction, however, is practical, the theoretical lessons not occupying more than one-third of the available time.

In both the secondary and elementary courses boarding pupils and day pupils are admitted, the number of the former being 24 in the secondary and 36 in the primary course. There are 15 day pupils in the secondary and 25 in the primary course. All these 100 pupils are required to attend the complete course, and in addition 30 voluntary pupils are admitted to the school to pursue special studies.

Boarding pupils pay $7 per month, except that 10 secondary and 15 elementary pupils are supported by the Government. Day pupils are instructed free of charge.

There are forty premiums of $20 each annually distributed as rewards for diligence and good scholarship.

The school possesses a museum of agricultural and forest products, seeds, soils, etc., also a meteorological station, library, chemical laboratory, horseshoeing shop, veterinary infirmary, cattle stables, etc. Services rendered by pupils outside of their apprenticeship are credited to them, and with other profits of the school form a fund for the benefit of pupils who complete their course.

Elementary Instruction.—The territory of Portugal is divided into agricultural regions, each one of which contains an official committee or agricultural society whose duty it is to promote agricultural progress in the region.

The practical schools of agriculture, viticulture, pomology, etc., are established in these several regions, and at them elementary in-

struction is given to train the pupils in locally appropriate rural pursuits. The theoretical and practical exercises correspond to the scope of instruction, and each school has its gardens, fields, museums, laboratories, etc., the internal organization corresponding to that of the Central School at Coimbra.

As an example the school at Faro may be taken. It contains one director and one chief, both of whom are professors and practical farmers; the chief may also, if necessary, be a veterinary surgeon. There are also an auxiliary professor, an agricultural regent, two overseers, a steward, a locksmith, a carpenter, and minor employés. The director's salary is $720 a year.

The instruction includes: The Portuguese language, arithmetic, agricultural geography, geometry and its applications, drawing, physics, chemistry, geology and meteorology, botany, arboriculture, agriculture proper, rural economy and administration, book keeping, zoölogy and exterior of domestic animals, hygiene.

This instruction is essentially practical, not more than one-third of each day's studies being given to theory. The course of instruction occupies three years.

Not more than 35 boarding pupils or 20 day pupils are admitted. The boarding pupils pay $4.50 per month, 15 of them being supported by the Government, while the day pupils are instructed free of charge. Thirty voluntary pupils may also be admitted for special studies. Ten premiums of $20 each are distributed annually to deserving scholars.

The practical schools were, with the exception of that at Castello de Paiva, organized in virtue of the decree of December 2, 1886. The schools at Faro and Vizeu treat of general agriculture, that of Santarem also includes pomology, that at Torres Vedras is a viticultural school, that at Bairrada includes viticulture and pomology, while that at Castello de Paiva is a practical dairy school, and was established in 1888.

The veterinary hospital at Lisbon, also established in 1886, is annexed to the institute. It consists of: (1) A hospital, popularly so called; (2) a pharmacy; (3) a medico-veterinary consultation bureau; (4) a farriery.

As an adjunct to instruction at the Institute this hospital is designed for: (1) Practical instruction for pupils of the Institute in veterinary medicine; (2) apprenticeship in modern processes of microscope analysis, bacteriology, and medical chemistry; (3) practical instruction of youths who intend to follow the trade of farriery; (4) practical instruction of those who wish to pursue the calling of grooms and to have the care of animals.

The hospital section comprises: (1) Infirmaries for the medical and surgical treatment of horses and asses; (2) an infirmary for both medical and surgical treatment of cattle; (3) an infirmary adapted

to the treatment of small animals; (4) an infirmary for the treatment of large animals suspected of contagious diseases; (5) an infirmary for the treatment of curable cases of contagious diseases; (6) an institution for the study of incurable contagious diseases; (7) a hydrotherapeutic establishment for animals; (8) an institution for the isolation of diseased animals subjected to special regimen.

Provision is also made for other infirmaries, etc., which the progress of science may show to be necessary.

The medico-veterinary consultation bureau comprises: (1) An establishment for examination of and consultation over large and small animals; (2) a registration bureau for animals admitted to the infirmaries, etc.

The pharmacy is supplied with all necessary arrangements for preparation of medicines, both those for the use of the hospital and those which may be sold to private owners of horses or cattle. The farriery, or siderotechnic shop, is also amply equipped. The institution is also supplied with all necessary material for service, harness, forage, lodging for employés, etc.

The technical and administrative direction is intrusted to a committee consisting of the professors of the veterinary section of the Institute and of the professors of zoötechny. The director of the Institute is president of this committee, and the inspector of the hospital is vice-president.

The decree of 1886 also created a number of chemico-agricultural stations in Portugal for the examination of samples sent by the public, the sending of such samples, fees for analysis, etc., being regulated by law.

ROUMANIA.

There is at Ferestreu, near Bucharest, a school of agriculture together with one for pomology and one for the manufacture of machines and instruments. These schools possess a nursery, silkworm establishment, a model farm, with experiment fields, kitchen garden, orchards, and museum; meteorological observations are also made there.

There is also at Jassy a special school for the construction of agricultural machines, together with four large nurseries for fruit and forest trees. In addition, there is a model haras at Nucet, while agricultural courses are given in eight seminaries, and there are annual fairs and exhibitions in the various districts. It is to be regretted that Roumania did not supplement her fine agricultural show with exhibits from some of these schools.

RUSSIA AND FINLAND.

These countries made no exhibit in Class 73 *ter*. In the latter country there is one agricultural institute with ten professors.

There are, besides, thirteen lesser schools of agriculture, fifteen of dairy work, one forestry institute, one school for forest guards, and one of horticulture. The total subsidy of the Russian Government for technical schools of all sorts in Finland is about $152,000 annually.

SAN MARINO.

The college founded in 1691 possesses a professorship of agriculture. A large chart of the technology of practical agriculture was exhibited.

SERVIA.

There is an agricultural school at Kralievo to which thirty pupils are admitted yearly, the course occupying three years. The pupils are exercised in all the operations of farming, both in the field and as concerns cattle.

Agricultural study has also been made obligatory in the higher classes of village primary schools. This study includes the culture of fruit trees, apiculture, and occasionally the culture of the silkworm.

SWEDEN.

Previously to 1870 Sweden used to import dairy products, but since that year she has exported them. This is due to efforts made by the Government to extend agricultural instruction in the country. There are two establishments for superior education of this sort, one at Upsala and one at Alnarp. There are also two intermediate schools for dairy work, principally for young women, and there are 16 dairy stations, each receiving two pupils, and each furnished with the most improved instruments. Besides these a nomad instructor in dairy management is attached to the agricultural society in each division of the country, the whole being under an instructor-general.

SWITZERLAND.

There are three practical agricultural schools, viz: at Strickhof, near Zurich, at Rütti, near Berne, and at Cernier, in the canton of Neuchâtel. These are all subsidized by the State, and all receive boarding pupils. At Strickhof there are generally about sixty pupils, the course occupying two years. At Rütti there are eighty pupils, and the course occupies two years, with a preparatory course of training for one year. The school at Cernier is of recent organization, and has but twenty-eight pupils, a number which it is thought unadvisable to increase while the course occupies two years.

The instruction given at these schools is essentially theoretical during the winter season and practical during the summer. Each school has a domain or farm attached to it, as also a tract of forest land, which are cultivated and cared for by the pupils. At Cernier

the instruction is theoretical and practical upon alternate days. The school at Rütti is provided with a chemical laboratory.

Instruction in agriculture and sylviculture is also given at the polytechnic institute at Zurich, and occupies from 2½ to 3 years. Candidates for admission must be 18 years of age.

As to special schools, there is a prosperous school of horticulture at Geneva, and there are dairy schools at Lausanne and in the cantons of Berne, Freyburg, and St. Gallen. There are also two veterinary schools, one in the canton of Berne and one in that of Zurich. At these schools candidates must be 17 years of age, and must pass a special examination for entrance, which is provided for at the former school by preparatory instruction for six months. These schools have at their disposition a *clinique ambulante* for the study of equine and bovine diseases.

Since the statute of June, 1884, for the encouragement of agriculture went into force, winter courses of rural instruction have been organized at Lausanne, Zug, Sursee, and other places, and are found to be of great advantage. There are also temporary courses in arboriculture held at three different seasons of the year. The first course is held just after the close of the winter, when pruning and grafting are going on, the second during the summer, and the third at the time of the first harvest. In Switzerland a custom prevails of planting fruit trees along the public roads, and it has been found that in some cases the revenue from these trees is sufficient to keep the roads in repair.

The expenses of the cantonal schools in 1886, and the subsidies allowed them by the State, were as follows:

	Pupils.	Cantonal expense.	State subsidy.
		Francs.	*Francs.*
Strickhof	51	23,467	10,166
Rütti	59	25,931	8,895
Cernier	28	24,438	12,219
	138	73,836	31,280

Those of the winter schools were:

	Pupils.	Cantonal expense.	State subsidy.
		Francs.	*Francs.*
Sursee	39	7,966	2,064
Zug	10	4,613	1,538
Lausanne	39	10,132	2,035
	88	22,711	5,637

Nomadic Instruction.—M. de Ribeaucourt, in a paper read at the agricultural congress, pointed out that in several European countries gratuitous instruction is given in certain branches of rural

economy by itinerant teachers supported by the State. This has been particularly in vogue in Switzerland for the past twenty years.

At first the cantonal authorities employed certain specialists to give lectures in localities where special instruction seemed to be necessary. These lectures proved to be of great popular interest, and were attended by all classes and by both sexes.

The cantonal authorities and agricultural societies, seeing the success of this movement, prevailed upon the national Government to allow it a state subsidy, which formed part of the general subsidy voted in 1884 for the general encouragement of agriculture.

The greatest success among these cantonal lectures was found to attend those upon apiculture after modern methods. Apicultural instruction has indeed made wonderful progress in Switzerland, and has also been successful in Austria, Germany, and Italy. The Swiss Apicultural Society, founded in 1861 by 93 bee-keepers from various cantons of German Switzerland, now numbers 600 members, and has 1,800 subscribers to its publications. Local and federal exhibitions of apiculture have also contributed to the development of the industry, but the greatest progress is admitted to have been derived from nomad instruction.

In French Switzerland apiculture has been included in the course of instruction given at Lausanne since 1875. An apicultural society was founded in the canton of Vaud in 1876, and has at present 300 regular members, with 11 branches comprising 500 more. Similar societies have been founded in the cantons of Geneva, Neuchâtel, Freyburg, and free public itinerant courses of instruction are everywhere given.

JAPAN.

Agricultural instruction is given in the Superior Normal School at Tokio, and in forty-six ordinary normal schools throughout the country. The expenses of the superior school are paid by the State, those of the others are covered by local taxes. A custom prevails of teaching agriculture, along with manual labor and military science, to young men alone, reserving domestic economy for female pupils exclusively. Agriculture also enters into ordinary secondary instruction and is soon to be introduced into superior secondary instruction.

SOUTH AFRICAN REPUBLIC.

At Pretoria there is a government school of secondary instruction which includes agriculture among its higher branches.

AUSTRALIA.

Victoria.—An act for the establishment of agricultural colleges was passed in 1884. This act provides for the permanent reservation of 150,000 acres of crown lands for the endowment of such col-

leges and experiment stations, and also for the appointment of a council of agricultural education consisting of eleven members.

The first school to be opened under this act was that at the Dookie experimental farm, October, 1886. About 5,000 acres are allotted to it, 15 of which are devoted to experimental culture. Instruction is given gratis, but a payment of £25 per annum must be made for each pupil to cover cost of maintenance. The course of instruction occupies from two to three years, and comprises chemistry, botany, entomology, geology, advanced English, arithmetic, mensuration, surveying, bookkeeping, practical farm work, field operations, the use of farm implements, and the management of live stock. In 1888 there were about forty pupils at the school, with many waiting for vacancies.

A second school has been opened at Longeronong, and three more are projected. These five schools will be all affiliated to a central college where more advanced instruction will be given.

South Australia.—There is an agricultural college upon the government experimental farm at Roseworthy, about 30 miles from Adelaide. The students are divided into two categories, practical and scientific. The practical students work upon the farm and receive regular wages for their labor, while the scientific students pay an annual fee of £50 for tuition and maintenance.

BRAZIL.

Generally speaking, the development of agricultural institutions is directly proportionate to the need of them in any country, and consequently in inverse proportion to the fertility of the soil. Brazil, an extremely fertile country by nature, and one in which but slight cultivation is necessary, did not, until within a few years, feel the need of such institutions. In May, 1888, however, the last remaining slaves were freed, and this fact has given an impetus to agriculture. The holders of large estates, having been deprived of slave labor, are now obliged to pay for labor, and in order to reduce the additional expenses thus incurred they must have recourse to economic methods, and must profit by scientific instruction. Small cultivators, whose number is constantly increasing through immigration, are dependent upon such institutions for instruction in new methods of intensive cultivation. This has been well understood at the ministry of agriculture, and in 1888 the Government was solicited in favor of the creation of new agricultural establishments in addition to those already in existence. This solicitation was so successful that in 1889 a credit of 408 contos, or about $230,000, was voted for the creation of certain agronomic stations, and the impetus needed for agriculture was attained.

The most important agricultural schools in Brazil are the following:

The Agricultural Orphan Asylum has been in operation since June, 1868. In 1884 it was moved into a building especially constructed for its use at the farm of Macaco, about 2 kilometers from the botanical garden, with which it is connected by a narrow-guage railway.

This building, situated at a height of 60 meters (197 feet) above sea level, is completely furnished and has a large garden, stables, cattle houses, etc., connected with it. The school possesses a library of some 400 volumes, apparatus for the experimental crushing of sugar cane, the making of manioc flour, a cotton gin, and an establishment for the raising of silk worms, etc.

The maximum age at which pupils may be admitted has been fixed at 14 years, and they must be orphans and hardy enough to perform field work. They are cared for at the expense of the asylum and are even given a small salary. The instruction comprises ordinary primary instruction, including geography, mathematics, bookkeeping, and linear drawing, also practical agriculture, the use of farm implements, preparatory manipulation of the soil, the treatment of vegetables, practical study of fertilizers, care of domestic animals, etc. Higher instruction comprises studies upon the tissues of vegetables and upon their organs and functions, the art of grafting, gardening, drainage, and irrigation.

In 1889 the school contained 28 pupils, the limit being 40.

The school of San-Bento-de-Lages was created by the institute at Bahia in 1876, and occupies a large building formerly belonging to a Benedictine monastery at San Francisco, upon the Brazilian coast.

Two different degrees of instruction are given. The elementary course is for those pupils who intend to become farm overseers or foremen in the forestry service. The superior course is for those who are to become agronomists or engineers of agriculture, forestry, or veterinary science. The instruction in both courses is essentially practical, with a requisite amount of theory. There are four general divisions of the instruction into sylviculture, agricultural engineering, agronomy, and veterinary science. Upon graduation pupils receive either a degree as agricultural engineer or a simple certificate of proficiency, according as they have followed one or the other course. Particular attention is given to field work, which is performed upon large tracts of land connected with the school. There are also physical and chemical laboratories, anatomical, zoölogical and geological collections, and a library of over 2,000 volumes. The personnel is composed of a director, several professors, a secretary, and a treasurer. The school is open from February 15 to December 15, and is well patronized, though as yet its full limit of 100 boarding pupils has not been reached. The number of day pupils is unlimited.

The rural establishment at San Pedro d'Alcantara was founded

in 1873, and was to occupy five of the national farms with a generous subsidy, but its proposed director having died nothing seems to have been done until 1884, when the school was definitely established. The school became a professional one for liberated slaves and free children of slave mothers. It was largely endowed and its success seemed assured. At one time it had 89 pupils, but this number had fallen to 29 in 1886, and in 1888 the Government transformed it into a school of zoötechny with an annual subsidy of $4,400. It is now hoped that the establishment will succeed. The live stock comprises about 10,000 head of cattle, 1,000 horses and mules, and 122 sheep, besides a large number of poultry.

The Isabel Orphan Asylum, or colony, was founded at Pernambuco in 1874 for the instruction of orphans and minors without protection in agriculture, and also receives a few paying pupils. It is subsidized by the state and possesses large fields for cultivation and a factory for crushing sugar cane. There are about 150 pupils and its products find a ready market.

The agricultural school at Piracicaba was established in the province of Minas-Geraes in 1875 for the purpose of disseminating in the province the knowledge of agricultural science and the use of farm implements and also for promoting the creation of farm schools among immigrants. It receives pupils over the age of 12 for a 3 years' course in theoretical and practical agriculture and has already rendered great service to local farmers. Its experiments in wheat culture have given excellent results and tend to increase the production of wheat in the province. Immigrants and their families are maintained gratuitously for a year at the school.

The Blaziana colony gives its pupils theoretical and practical instruction in agriculture in addition to the ordinary elementary instruction of the Brazilian schools. The land belonging to the colony is of vast extent, and there are plantations containing 600 quince trees, 800 mulberry trees, 1,500 vines, 4,600 banana trees, and 8,000 coffee trees, besides plantations of sugar cane, manioc, flax, cotton, tobacco, wheat, vanilla, etc. There are about 70 pupils, of whom about half are orphans, and the state allows an annual subsidy of 6 contos ($3,400).

The provident institution near Belem, capital of the province of Para, was founded by the private charity of Bishop Macedo. About 75 children receive elementary instruction, together with practical instruction in various handicrafts, including agriculture. The principal object of study is the wood of the surrounding forests. Being still supported by private charity, the school receives but a small subsidy from the State.

The veterinary school at Pelotas is supported by the municipal government of that town, and is well provided with a fine building and all necessary grounds. Its object is to spread knowledge of agri-

culture, and especially of veterinary subjects in its province, Rio-Grande-do-Sul, which is particularly given to cattle-raising.

CHILE.

There exists at Santiago an agricultural institution which may be regarded as one of the most remarkable in the whole world. Despite its modest title of Quinta Normal de Agricultura, or small model farm (the word *quinta* signifies a country seat or farm house), it is virtually an agricultural university consisting of several separate establishments united under one head.

The history of the Quinta Normal is as follows: In 1838, the first Chilean agricultural society was founded for the diffusion of information among the farmers. Very soon the necessity of showing the farmers practical examples of cultivation and good models for imitation made itself felt, whereupon the society demanded and received from the Government a grant of land for the establishment of an experiment field. In 1842 the state gained possession of an estate of about 50 acres in the neighborhood of Santiago, and confided this to the above society for the establishment of a *quinta normal*, or small model farm.

The first few years of the existence of this farm were occupied in improving the land and adapting it to cultivation, and it was not until 1849 that the establishment received an organization adapted to its proposed object, and that the first agricultural school in Chile was erected.

After varying fortunes, this establishment became, in 1872, the field for the application of higher agricultural instruction, which was in that year introduced at the University of Santiago. In 1875, a congress of Chilean agriculturists, which met at the exposition at Santiago, formed plans for complete agricultural education appropriate to the country, and demanded from the Government the establishment of a college for higher instruction, and in 1876 the courses of this new establishment were opened to pupils. Organization was gradually completed between 1876 and 1883, various branches of instruction were created, new land was purchased and laid out, and finally a complete and costly apparatus was donated to the institution.

The buildings, land, and collections of all kinds now belonging to the Quinta Normal are valued at nearly $1,500,000. The total extent of land occupied is 130 hectares (321 acres). The whole is the property of the State and is placed under the direction of the national society of agriculture as regards cultivation and experiments in agronomy, and under that of the council of the agricultural institute as regards theoretical and practical instruction. The direction and administration are exercised by two special directors appointed by the Government, one of whom has charge of all vegetable pro-

ducts and studies, etc., the other of those which concern animals. The situation is to the west of the city of Santiago at about 3 kilometers from its center and there is railway and tramway communication between the two.

The situation of the Quinta Normal is a healthy one and the temperature is more uniform than that of the city itself. The soil is alluvial, and varies in depth from 1 to 3 meters (3 to 10 feet) being moderately light and easily worked, though sometimes rather tenacious in places. Fine sand, clay, and humus predominate, with a little limestone. The subsoil is composed of sand, gravel, and rounded pebbles, and varies in depth from 50 to 100 meters (164 to 328 feet).

This subsoil is particularly favorable to irrigation, which becomes a question of great moment in a climate like that of Chile, where there is but little annual rainfall. Irrigation is practiced the year round, and thus continuous vegetation is kept up, and mowing may be done during every month in the year. The water is supplied by a canal from the Maipu River and the sewage of Santiago is also utilized. The waters of the Maipu are clear during the winter (June, July, and August) and charged with alluvial matter in the summer (December to February). The amount of water supplied to the Quinta Normal is 15 liters per second from each of 13 points of supply, or in all 195 liters (51½ gallons) per second—an ample supply for all needs.

The estate is well supplied with avenues and ordinary roads, the total length of these being about 9 kilometers, or 5½ miles, and all of them being bordered by double or triple rows of shade trees, many of which are acclimated from all parts of the world. There are also many hedges, and a Decauville railway is soon to be established.

As has been said, the Quinta Normal comprises several separate establishments. The budget for these in 1889 was, in United States money, as follows:

Agricultural institute	$19,554
Agronomic station	6,540
Practical school	37,560
Zoölogical garden	7,000
Establishment for pisciculture and aquarium	6,000
Institute of animal vaccine	4,600
Total	$81,254

In addition to these there is also a veterinary hospital and a laboratory for the preparation of charbon virus, in both of which the expenses are covered by the receipts.

The Agricultural Institute.—In Chile real estate has not yet been greatly subdivided, and large domains belonging to wealthy proprie-

tors are usual; therefore superior instruction in agriculture is demanded for these proprietors, many of whom cultivate their own estates.

This demand has resulted in the creation of the Agricultural Institute at the Quinta Normal, which was inaugurated in 1876, and is now in full prosperity and perfectly fulfills all its requirements, ranking with the best of such institutions in any country of the world.

The instruction given comprises (1) agriculture, (2) rural economy and accounts, (3) arboriculture and horticulture, (4) viticulture and vinification, (5) agricultural botany, (6) comparative anatomy and physiology of domestic animals, (7) exterior of domestic animals, (8) general zoötechny, (9) special and veterinary zoötechny, (10) general chemistry, organic and inorganic, (11) analytic chemistry and agricultural chemistry and technology, (12) rural engineering and construction, (13) rural legislation. In addition to these there is a preparatory course consisting of (1) mineralogy, geology, and zoölogy applied to agriculture, (2) elementary mathematics, trigonometry, linear drawing and bookkeeping, (3) elements of physics and mineralogy. There are also special lectures in entomology, apiculture, sericiculture, pisciculture, and rural hygiene.

The Institute is provided with an agricultural library, a museum of products, machines, and apparatus, an agronomic station with chemical laboratories attached, a meteorological observatory, an experiment field, a garden for dendrology, and many other similar conveniences, including gardens and plantations of every description, vineyards and wine-making and distilling apparatus, sericicultural, apicultural, and piscicultural establishments, a farriery and a veterinary hospital, etc.

The president of the National Agricultural Society is also president of the council of eight members which governs the Institute; the members of this council are partly appointed by the President of the Republic and partly by the agricultural society.

The personnel of instruction consists of professors of each of the thirteen courses above mentioned, together with lectures upon entomology, apiculture, sericiculture, pisciculture, and rural hygiene, tutors and instructors in the various agricultural, mathematical, and chemical courses, and masters of practical work in vegetable and animal industries.

Instruction is public and entirely free. The pupils are generally day scholars, though there is also a boarding school in connection with the Quinta Normal. In addition to the pupils of the preparatory and higher courses the public are freely admitted to all lectures.

Pupils for admission to the higher courses must be at least 16 years of age, and must pass an entrance examination upon ordinary branches of education; a less extensive examination is required for entrance to the preparatory school. The duration of the superior

course is three years and that of the preparatory course one year. Practical instruction is completed by visits to factories and farms of interest and by excursions to various parts of the Republic. Pupils also have access to practical instruction in the other establishments of the Quinta Normal. Three months' vacation (December 15 to March 15) are given each year, but the pupils, as in France, are required to devote themselves during this vacation to practical work, and to render an account of it upon rejoining the school.

The instruction is, as in American colleges, partly elective, and great stress is laid upon the taking of notes by all pupils. Monthly oral examinations are held and there are two general examinations yearly, at the end of July and at the middle of December, which are partly oral and partly in writing. At the end of their three years' course satisfactory pupils receive the degree of agronomist from the Government, except those who have pursued an elective course, who receive diplomas of efficiency. Agronomists who are also bachelors of science may aspire to the degree of agricultural engineer, which is conferred upon them after they have passed a special examination, generally a very difficult one.

A detailed programme of the course of instruction at this institute, as given in M. Le Feuvre's magnificent work, "La Quinta Normal de Agricultura," shows it to be extremely complete. [I should say here that although there was no regular exhibition of the work or products of the Quinta Normal and its institutions at Paris, this book, especially prepared for the Exposition, was freely distributed by the Chilean commission to the agricultural commissioners of all the other exhibiting nations, and it is from this that these notes are taken.]

The library of the institute contains some 2,600 volumes and 1,200 pamphlets, and also subscribes for 45 periodical agricultural publications; of the latter 23 come from Paris, 4 from London, and only 4 from the United States. The collection of specimens and models in the museum is a very large and complete one.

From its foundation in 1876 to the end of 1888 the institute had admitted 387 pupils, and during the same period had conferred 8 degrees of agricultural engineer and 52 of agronomist, and had issued 83 certificates of proficiency. The number of those who have taken degrees or certificates, 143 in all, is only about 37 per cent of the total number of pupils admitted. This is due to two principal causes: in the first place the preparation for the examination for entrance is often so insufficient that although candidates may pass the examination and be admitted, they find themselves unable to keep up with the studies of the first year; in the second place, in a country like Chile, young men study, not for the sake of education alone, but in order to make that education profitable as quickly as possible, and therefore many only pursue half the course

and then accept situations upon large farms or cultivate their own lands. Those who finish their course and take a degree are sure of occupation, and all the Chilean practical schools of agriculture are directed by the graduates of the institute. The neighboring republics also seek such graduates, giving them advantageous positions.

This institute has also proved of benefit to Chile in another way, that is by the propagation in the country of new cultural and zoötechnical methods. In this way it has introduced the cultivation of tobacco, of violet clover, of sugar-beet, of the topinambour, and of ramie, all of which were previously unknown in Chile, and it has also introduced the use of guano and nitrate of soda, winter irrigation, the use of oil-cake for cattle, various veterinary receipts, etc. It has also introduced many important machines into Chilean agriculture, and has propagated Durham short-horns, Percheron horses, Merino sheep, the best breeds of poultry, etc. Collections of Chilean products are made and sent to European countries, where a better acquaintance with Chile has been found desirable.

The agronomic Station.—This is an important complement to the Agricultural Institute, and at first formed part of it, but was afterwards made independent.

The object of this station is to make researches relative to the principal agricultural industries of the country, such as the comparative value of certain crops, the acclimatization of new plants and new varieties of domestic animals, the trial of fertilizers, studies upon irrigation, diseases of plants, analysis of soils, observations of meteorological phenomena, and finally to serve as an authority for consultation upon agricultural matters in general. Practical instruction in chemistry is also given to pupils of the institute, and the professors are greatly aided by the station in preparing their lectures.

The personnel of the station consists of one director, one assistant, who gives lectures in chemistry, and one aid.

The practical school was founded in 1885, and is especially intended for the production of skilled workmen who shall be capable of directing all the various operations of a large farm, more especially in the arts of vine-growing, wine-making, arboriculture, and dairy work.

The school is placed under the surveillance of the superior council of the institute, and its personnel of administration and instruction consists of a director-general, who is also director-general of the Quinta Normal; a special director of animal industry, who also holds the same office for the Quinta Normal; a deputy director, who is especially attached to the school; professors of agriculture, elementary zoötechny, and applied geometry; three inspectors who have charge of primary instruction, and finally a chaplain.

All these are appointed by the superior council of the institute, while the following are appointed by the director general: A chief of cultivation; an arboriculturist; a viticulturist; a master of wine-making; a chief of the stables and dairy; a gardener; and there are also other employés, such as a mechanician, blacksmith, wheelwright, cowherd, etc.

Instruction is gratuitous. The course of instruction occupies four years, and the school is capable of receiving 100 pupils at once, or 25 in each year's class. The pupils board at the school. For admission preference is given to the sons of soldiers killed in the late war with Peru, and after that to those who have passed the best examination. Pupils must be between 15 and 20 years of age, of sound constitution, and must be able to read and write, and must know ordinary elementary arithmetic. A certificate of vaccination is also required.

The Veterinary Hospital.—Twenty-five years ago domestic animals were very cheap in Chile, and when an animal was lost through disease or accident it was easily replaced. Since that time, however, the value of ordinary domestic animals has more than tripled, while numerous varieties of cattle, sheep, swine, and horses have been introduced from Europe at great cost, so that veterinary art has become a necessity. Therefore, in 1877, the Society of Agriculture founded a veterinary hospital at the Quinta Normal.

This hospital serves a double purpose. In the first place, it receives diseased animals from the farmers and treats them according to a fixed tariff, certain regulations being observed. At the same time, the animals thus cared for serve as practical subjects for the zoötechnical and veterinary courses at the institute. The cows belonging to the Institute of Animal Vaccine are, in the second place, provided for at the hospital, and animals recently imported are brought there for quarantine, and to recover from the effects of their sea voyage. The expenses of this hospital are entirely covered by its receipts, so that no subsidy is needed from the State.

The Institute of Animal Vaccine.—Formerly great ravages, especially among the lower classes, were caused in Chile by the small pox. In order to combat this plague the Government accepted the offer of the Society of Agriculture, and in 1887 established this institute at the Quinta Normal.

Its object is to obtain, prepare, and preserve vaccine virus, and to supply it to the vaccination service throughout the Republic. The organization of the establishment is after the plan most approved in similar European establishments, and the material and instruments are most complete. The physicians of Peru and Bolivia also obtain their virus from this institute.

Laboratory for Charbon Virus.—The disease known as *anthrax* or *bacteridian charbon* is very common in Chile among the cattle.

Therefore the same society has created at the Quinta Normal a laboratory for the preparation of virus for inoculating cattle and thus preventing the spread of the disease. The process of M. Chauveau is the one preferred. In 1887 the laboratory inoculated 15,000 head of cattle, and in 1888 provision was made for 100,000 head. The laboratory is self-sustaining.

The Quinta Normal is also provided with a zoölogical garden, an establishment for pisciculture, and an aquarium, a very extensive series of vineyards, together with cellars and apparatus for wine-making, a large collection of agricultural machines, experiment fields, nurseries, gardens of all sorts, cattle houses, and dairies, which want of space forbids me to describe. Suffice it to say that everything is of the best quality obtainable, and that all these advantages are placed freely at the disposal of the pupils of the institute and of the practical school. The whole Quinta Normal may be referred to as a model institution in every particular.

Besides the above Chile possesses practical schools of agriculture in six different towns, all of which are more or less subsidized by the State.

MEXICO.

The exhibit made by this country was particularly interesting in regard to statistics and agricultural instruction. Carefully prepared charts gave full information concerning the climate, nature of the soil, distribution of moisture, nature and distribution of crops, etc., while a commission appointed for the purpose exhibited a collection of the agricultural products of the country. This work was the more important, since there had previously been no accurate data with regard to such productions in Mexico.

By a law passed in 1883 agricultural and veterinary instruction received complete reorganization and were placed under the supervision of the minister of public works. The great school of Mexico at which such instruction is given admits pupils at the age of 12, the only requisite for admission being a good primary education. The instruction occupies seven years, and is judiciously apportioned between literary and scientific subjects, theory and practice, the latter being supplied upon a well-appointed experimental farm. At the end of each school year scientific excursions are made to different points of the Republic, the pupils thus studying the flora and fauna of the country, and the mode of cultivation appropriate to tropical, temperate, and cold climates, Mexico possessing all these climates according to altitude. Industrial and agricultural establishments are also visited; so that at the end of his course the pupil possesses an almost complete knowledge of his native country, a plan well worthy of imitation in other lands.

In the Mexican schools tuition is entirely gratuitous, and pupils

may live either at the school or elsewhere. The Agricultural School has an income of $100,000 and the Government has established sixteen scholarships of $300 each for poor pupils, who, however, may lose their scholarships should they not pass satisfactory examinations. The school is at once an institution of higher instruction and a secondary school, and at the end of his seven years' course the successful pupil receives a diploma as agricultural engineer or veterinary surgeon.

For the Veterinary School there is a large hospital, with stables and cattle sheds containing various types of domestic animals, and there are also farriery shops, etc. The Mexican Government has been prodigal of expense, and has spared no effort to make its schools successful.

CHAPTER IV.

CLASS 74—SPECIMENS OF FARM IMPROVEMENTS AND AGRICULTURAL WORKS.

By C. V. RILEY and AMORY AUSTIN.

Models of farm buildings of various countries.
Designs of stables, cattle houses, sheep sheds and folds, pigsties, and buildings for raising and fattening animals.
Appliances for stables, cattle houses, kennels, etc.
Apparatus for preparing food for animals.
Agricultural machines in operation: Steam plows, reapers, mowers, haymakers, threshers, etc.
Designs of agricultural works: Distilleries, sugar mills, refineries, breweries, flour mills, fecula and starch factories, silkworm nurseries, cheese factories, dairies.
Presses for cider and oil.
Models of poultry houses, pigeon houses, pheasant houses.
Apparatus for artificial hatching.
Models of kennels.

In the French exhibit upon the Quai d'Orsay the classification above given was by no means strictly adhered to. Only about three-fourths of the list was there represented, the remaining fourth being scattered among Classes 49, 50, 75, and 76, while its place was supplied by the vegetables properly belonging to Class 71, and the cereals, which, though classified under Class 67, were not exhibited there.

The French exhibit occupied the whole of two galleries upon the Quai. One of these was devoted to collective exhibits, 44 in number, and the other to the contributions made by 273 exhibitors.

Among the collective exhibits those coming from the farmers of the Departments of Pas-de-Calais, Nord, and Seine-et-Marne were particularly noticeable, and each was awarded a grand prize by the jury. In the exhibit of Pas-de-Calais the most striking feature was the show of wheat, of which there were some thirty varieties, together with some twenty of oats and several of barley. These grains were shown in the form of neat sheaves, each one being accompanied by a large jar filled with the corresponding grain, and each variety being plainly marked with a card bearing the name, locality, year,

and yield per hectare in grain and straw, and also with other data. From these and similar data in other exhibits I have constructed the accompanying table of yields.

Pas-de-Calais had also a fine show of sugar beets with sugar made from them, all stages of the process being represented. There were also potatoes, chickory, linseed, etc.

The Department of the Nord had a fine show of wheat, including several samples of the harvest of 1889 just gathered; also of oats, barley, and rye. Some of the straw of the latter was 2 metres (6½ feet) long. There were also sugar beets, a large show of potatoes, and a fine one of hay and grasses.

The exhibit of the Department of Seine-et-Marne was made up of separate exhibits from its various arrondissements and towns: Fontainebleau, Provins, Coulommiers, Melun, and Meaux, that of Melun being especially rich in information given by means of cards as above described.

The largest, though not the best, exhibit was made by the Department of Cher, and a very large one, consisting principally of seeds, potatoes, cereals, and wool, was made by the Department of Aube

Fine potatoes were shown coming from Meurthe-et-Moselle, and excellent wheat from Creuse, Eure, Eure-et-Loir and Haute-Saône. The Department of Ille-et-Vilaine, in Brittany, vaunts itself as being the principal buckwheat-producing region of France, and the following curious statistics were conspicuously exhibited: "The buckwheat brought to Rennes averages 600,000 kilos annually, which makes 360,000 kilos of flour, which would make cakes enough, if piled one upon another, to reach four times as high as the Eiffel Tower, or, if placed edge to edge, would reach 2,000 kilometers (1,242 miles), or from Calais to Gibraltar." This Department also showed cereals, vegetables, butter, and cider.

These collective exhibits, as well as those of towns, agricultural clubs, and syndicates, were of a very miscellaneous character, showing, in addition to the above products, wines, colza, flax, tobacco, wool, cheese, honey and wax, ramie, eggs, and products of all sorts. There were also plans and models of farms, designs for irrigation and drainage, samples of ensilage, machines and instruments, alcohol from agricultural distilling, fertilizers of all sorts, and many products of manufacture. There were also publications upon various agricultural topics.

The second gallery devoted to Class 74, that containing the individual exhibits, was most interesting. There were several models of farms, next to which came an interesting exhibit made by the Compagnie Générale des Voitures de Paris, and displays made by five great seed houses of Paris, including those of MM. Vilmorin-Audrieux et Cie. and of MM. Forgeot et Cie, both of which houses are well known in America. The remainder of the gallery was occupied by exhibits

of avicultural appliances, such as incubators, of which there were many, *gaveuses*, etc., also by shows of veterinary medicines, instruments, etc., and minor miscellaneous articles.

Among the models of farm buildings, etc., the most important was that of the celebrated milk farm of Arcy-en-Brie, owned by M. Louis Nicolas, by whose invitation the farm was visited by members of the Agricultural Congress in July. An account of this visit and of the farm accompanies the report upon the proceedings of this congress (Chapter x).

Interesting also as typical French farms of the better sort are the establishments of M. Armand Moissant upon the domain of Donneterie (Indre-et-Loire). The domain is situated in the northern part of the department upon the line of the Orleans railway, and thus has easy communication with Tours and Le Mans. It was gradually acquired by M. Moissant, from 1877 to 1885, by the purchase of ten different farms and of twelve other parcels of land, the average price of the whole, including buildings, being 1,175 francs per hectare, or about $91 per acre.

There are in all 610 hectares (1,507 acres) of land, two-thirds of which are argillo-siliceous, the remaining third being argillo-calcareous. At the time of purchasing, the soil was in a lamentable state of exhaustion, caused by fifty years' negligence and unscientific cultivation The land was much cut up by poor hedges, and the roads were absolutely impracticable. Wheat and oats only yielded 12 to 15 hectoliters per hectare, and the pasturage was of the poorest description, affording a bare sustenance for a few inferior cattle. The argillo-calcareous soil was full of bowlders, while the impermeable argillo-siliceous soil retained stagnant waters through lack of drainage. In winter much of the domain was under water.

Under M. Moissant's direction the bowlders and hedges were removed, the land was thoroughly drained, and the roads already in existence were repaired. The domain was re-divided into large and convenient lots, and about 10 kilometers (6.21 miles) of new roads were constructed and bordered upon each side with apple trees, about 4,000 trees being used. The total length of drains constructed was about 60,000 meters (37 miles). The moist parts of the land which could not be prepared for cultivation without great expense, about 25 hectares, were planted with forest trees.

There are two principal farms upon the domain, that of Thoriau and that of Platé. The farm of Thoriau comprises 175 hectares and was constructed in 1880–'83. It is situated upon a declivity on the banks of a small stream, not far from the railway station. It consists of a group of buildings arranged around a central court, these buildings being constructed of ashlar, with iron and tile flooring and tiled roofs.

The principal industry at this farm is the making of butter and cheese, and all the milk produced at both farms is here utilized. The dairy is a subterranean one, an illustration of which is here shown (Pl. VIII). The floors here are of cement. It is provided with all the latest improvements in separators, churns, and other butter-making machinery, the motive power being supplied by a horse-power outside. Connected with this is a room for cheese-making. The butter is mostly sent to Paris, where most of it is consumed by private families, the excess going to the Halles, but the cheese, generally manufactured from skim milk, is consumed upon the farms. A part of the skim milk is utilized for the feeding of young pigs.

The farm of Platé comprises 230 hectares, and was constructed in 1885. The buildings, with their central court, cover the space of a hectare, or about 2½ acres. A reference to the illustration and plan (Pls. IX and XIII) will give a fair idea of this usual mode of arranging farms and buildings in France.

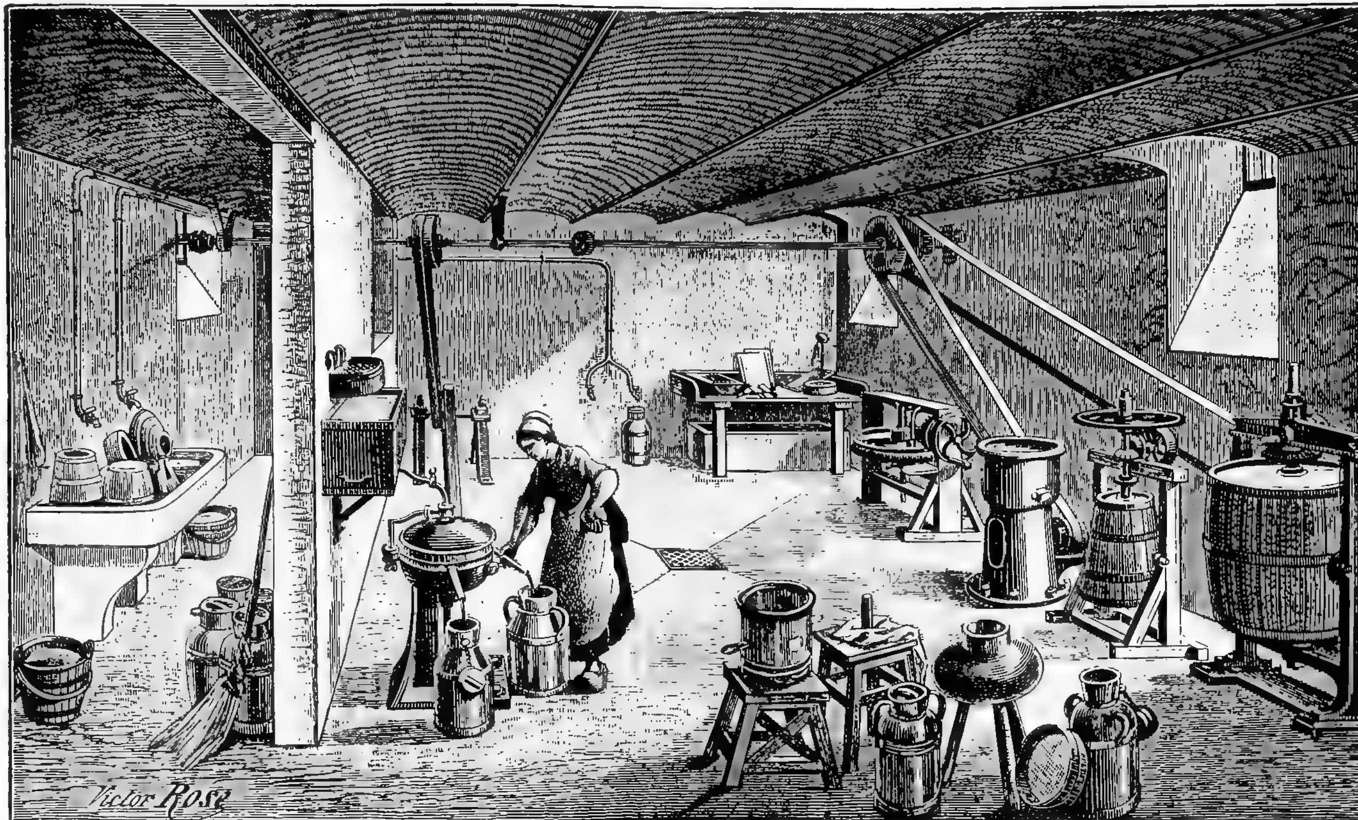
Plan of the farm of Platé.

[Explanation of Pl. X.]

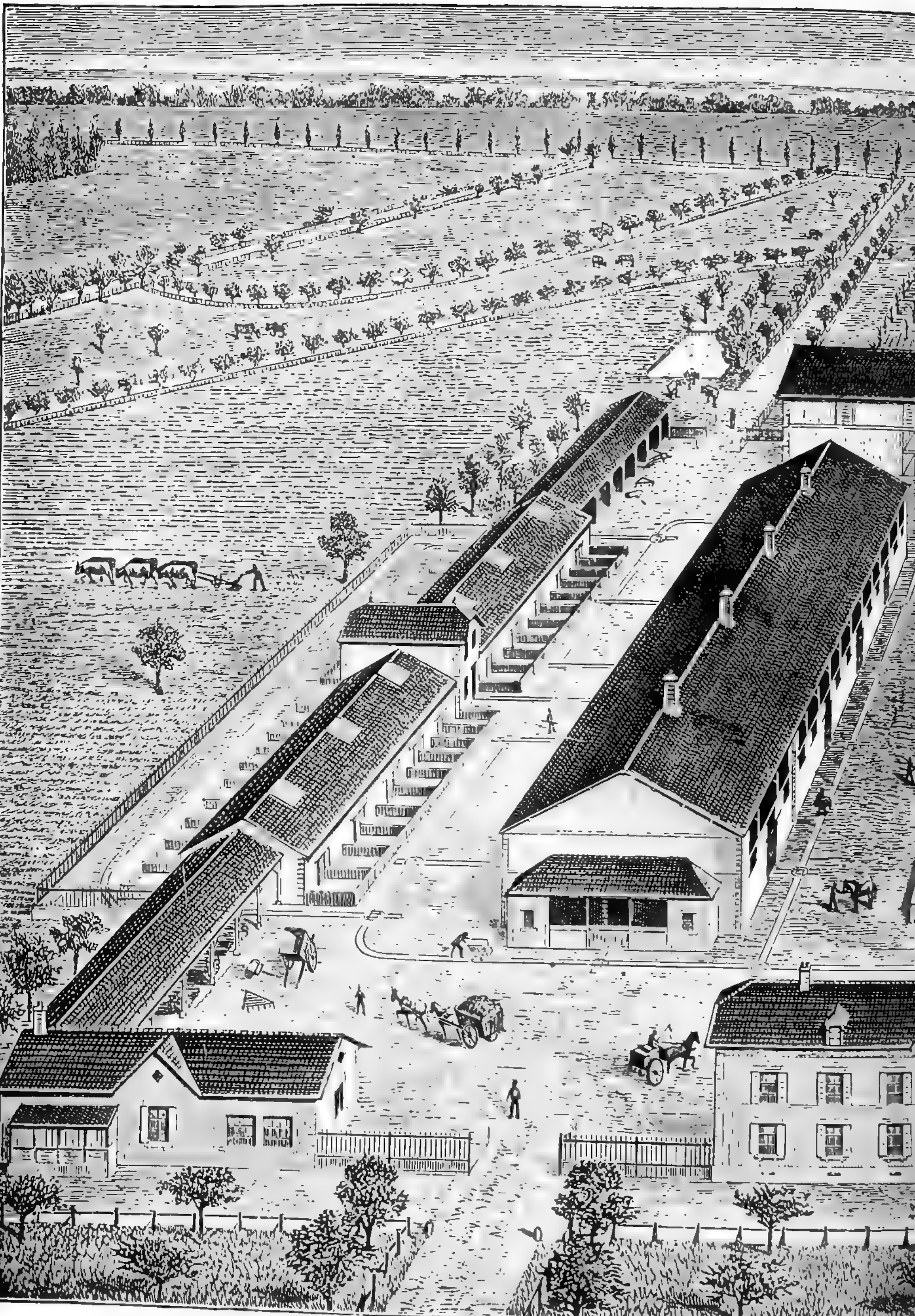
A. Dwelling house.
BB. Trenches for manure.
C. Cesspool.
D. Stables.
E. Sheepfold.
FF. Wagoners' sheds.
G. Large shed, with silos.
H. Workshop, repair shop, and store-house for fertilzers.
K. Steam engine.
LL. Granaries.
M. Cow stables.
N. Stables for oxen.
OO. Sheds.
PP. Pigsties.
Q. Bakery and dairy.
R. Press room.
S. Sheds.
TT. Poultry houses.
U. Hospital.

The buildings at Platé are constructed like those at Thoriau, of ashlar, with iron and tile floorings and tiled roofs. It being essentially a milk farm, great care has been taken in the construction of the cow stables. These will accommodate 64 cows, besides 16 oxen, and are clean, convenient, and well ventilated. The cows are arranged in two rows, their faces toward a central passage 2 meters in width, provided with a small railway. The stalls are 1.25 meters (4 feet) wide, and have no racks, but are provided with cement mangers or feeding basins, connected with which is a running water supply. The floor of the stable is cemented and well drained.

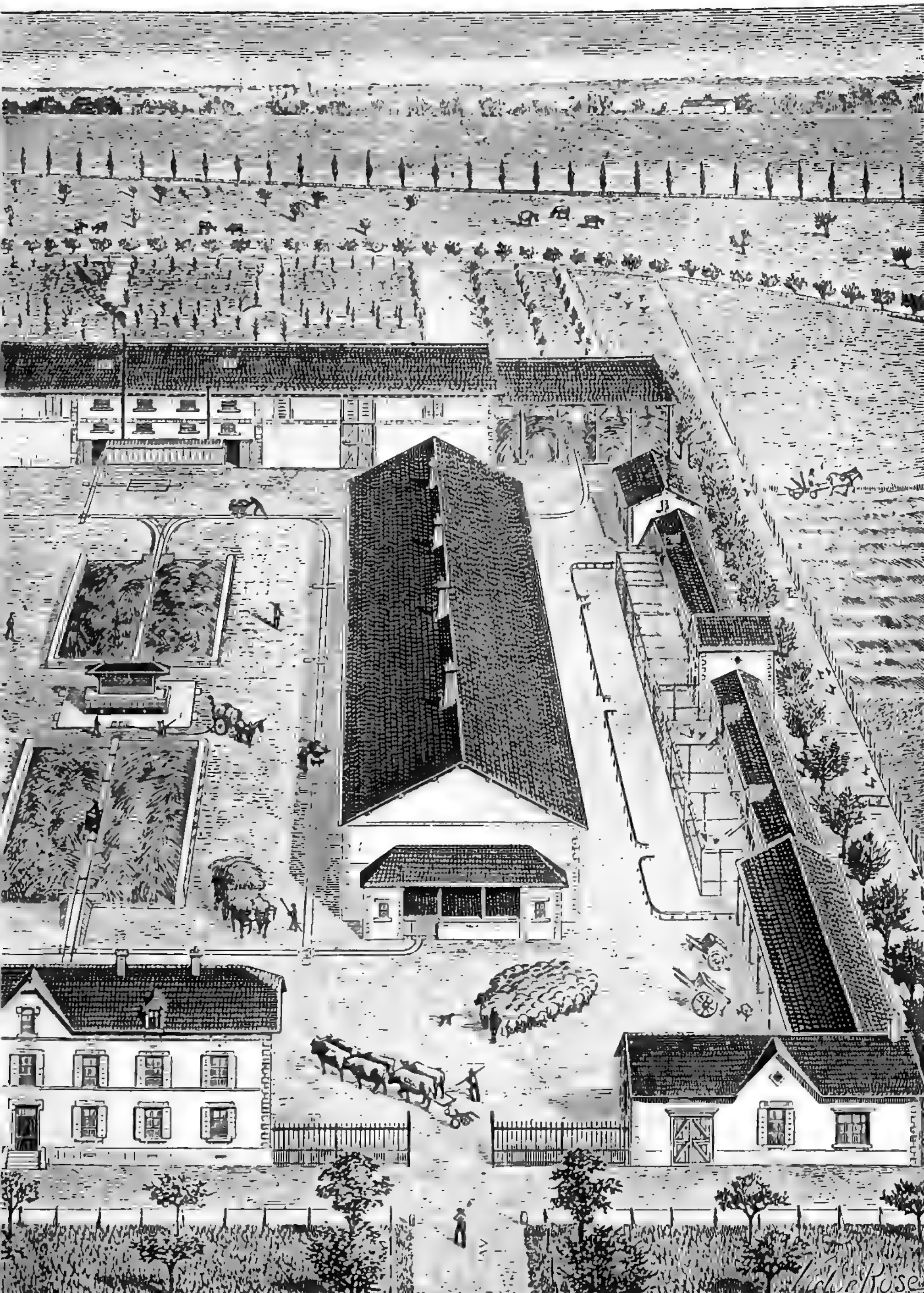
The sheepfold is divided by sliding partitions into four compartments for convenience in feeding. There is a flock of from 500 to 600 sheep, well cared for, and allowed plenty of space, a point not always thought of. In both the cow stables and the sheepfold there is a hayloft above, which is not so usual in France as with us. Ventilation is especially cared for by the construction of shafts through the roof, and by windows of simple mechanism. The for-



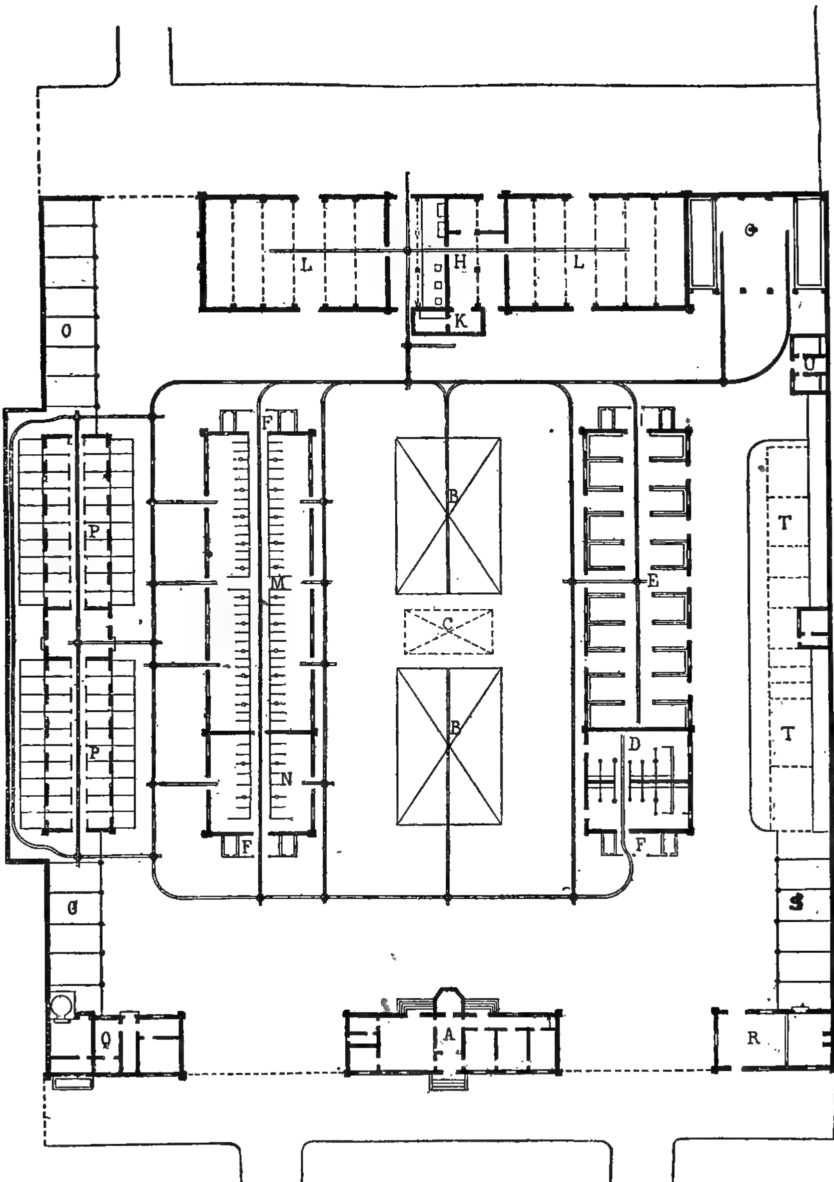
DAIRY AT THE FARM OF THORIAU.



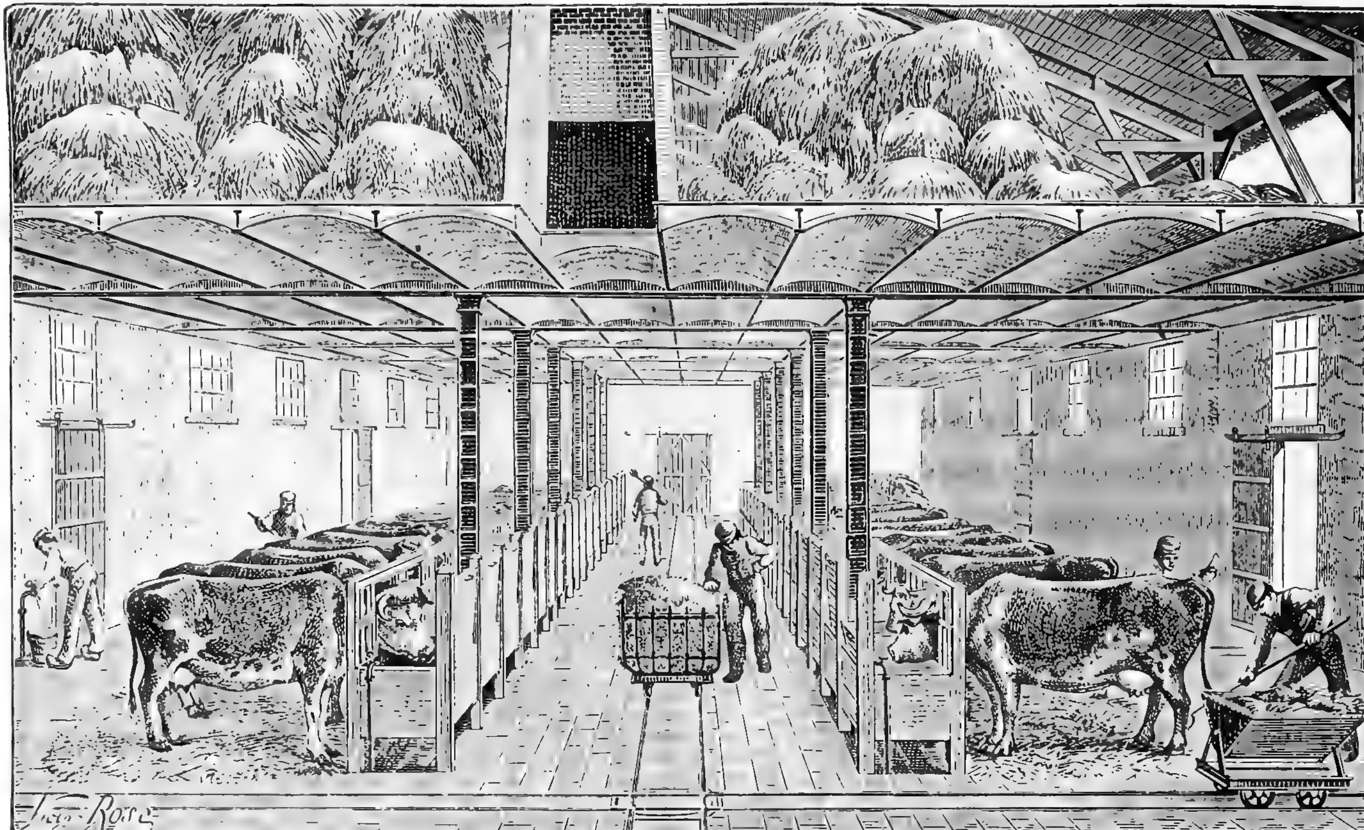
GENERAL VIEW OF



HE FARM OF PLATÉ.

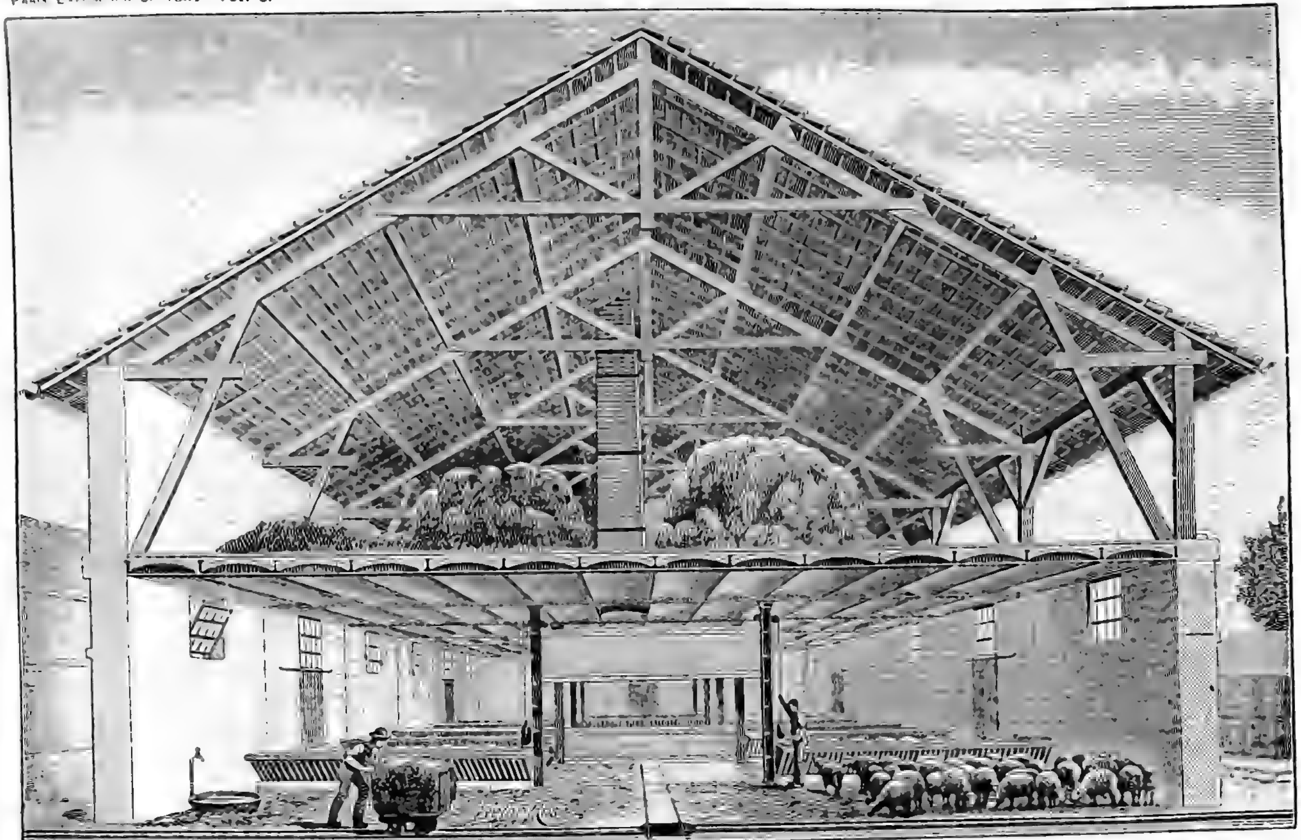


PLAN OF THE FARM BUILDINGS OF PLATÉ.

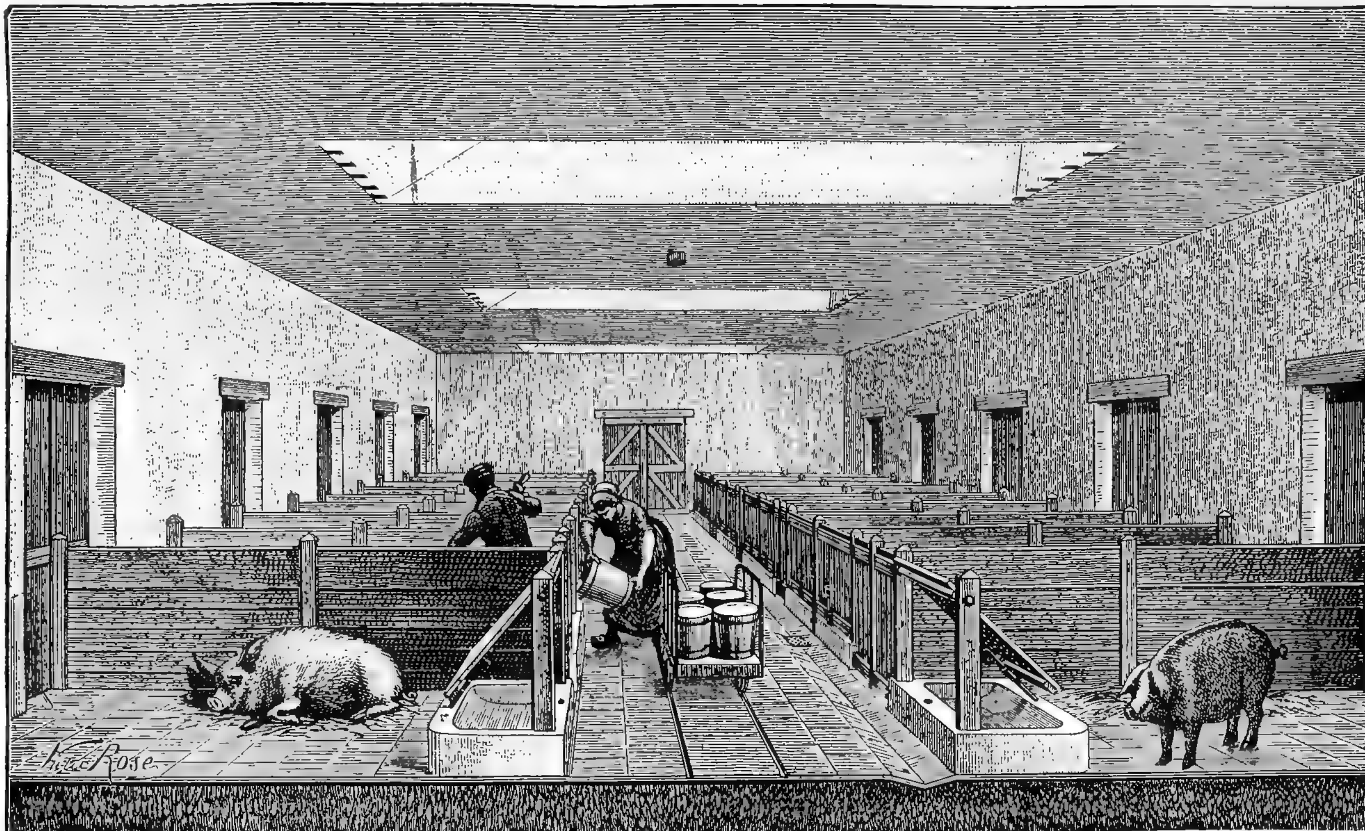


COW STABLE AT FARM OF PLATÉ.

SWINE HOUSE AT FARM OF PLATÉ.



SHEEP-FOLD AT FARM OF PLATÉ.



SWINE HOUSE AT FARM OF PLATÉ.

age in the loft is protected from emanations from the stalls by an impermeable flooring of cement.

The swine houses are low buildings without lofts, and are lighted from above. They are extremely clean and are provided with exterior pens. The construction and interior arrangements of these various buildings may be understood from the accompanying illustrations from "Les Grandes Usines de Turgau," June, 1888.

The live stock of the domain, both farms included, consists of 30 horses, 90 head of cattle, of all sorts, 500 sheep, 90 swine, and a very large number of poultry.

Among the horses there are 20 mares and 1 stallion, besides working horses, almost all being Percherons. Considerable breeding is done upon the farms, and in September, 1888, colts of 6 months brought 700 francs apiece there.

Of the cattle there are some 60 cows and 2 bulls, besides heifers, etc., and a working force of 80 oxen. These are all of pure Cotentin breed, and there are no Jerseys, as at the farm of Arcy. The 500 sheep are Bewichons or Bewichon-Disbleys, and there are 8 pure Southdown rams. This crossing is said to produce good results, and the annual product is from 400 to 420 lambs, which are sold for good prices when 6 months old. The swine are partly Yorkshire, with a few of the native swine of the region, which are derived from the Craon breed. About 250 young pigs are raised yearly, 200 of which are sold at the age of 8 or 9 weeks, the rest being fattened and sold at the age of 10 or 11 months.

The poultry are principally Dorkings, Breese, and Langshans, with turkeys of a native race, and Rouen ducks. These are not allowed to wander at will over the whole farm, as is often the custom in France, but are confined to their own houses and yards. Artificial hatching is extensively used. About 400 pullets, 100 young ducks, and 50 young turkeys are raised yearly. The eggs are sold, like the butter, to private families in Paris, and the poultry finds a ready sale there.

Upon the two farms there are 340 hectares under cultivation, and upon the rest of the domain 136 hectares are let out to small farmers. Upon purchasing the property one of the first things done was to have the soil analyzed, whereby it was found to be very poor in phosphoric acid, nitrogen, lime, and sulphuric acid, though the amount of potash was sufficient. To remedy this 1,200 kilos of natural phosphate of lime from the Ardennes were added per hectare, this treatment being followed by a moderate addition of lime where needed.

Of the 340 hectares cultivated there are about 40 hectares sown with lucern and sainfoin, which are allowed to remain for 4 or 5 years. About 100 hectares are sown with autumn wheat, and 90 with oats and barley, the rest being sown with clover, minette, vetches,

potatoes, carrots, forage beets, forage cabbage, and forage maize. For the beets and carrots 30,000 kilos of farmyard manure are used per hectare, and for maize or potatoes 25,000 kilos, this manure being supplemented by chemical fertilizers.

Some of the yields of the farm in 1888 were as follows: Wheat, average 30.60 hectoliters per hectare. Bordeaux wheat weighing 77.80 kilos and Kessingland 79.25 kilos to the hectoliter. In 1887 the harvest was a better one, the average being 32.10 hectoliters to the hectare, Bordeaux wheat weighing 79.50 kilos and Kessingland 80.50 kilos. From 1884 to 1886 the average was 28.80 hectoliters of wheat to the hectare, the hectoliter averaging 78 kilos. Oats, in 1888, averaging 40 hectoliters weighing 47 kilos, while in 1887 the average was only 33 hectoliters, and from 1884 to 1886 it was only 30.30 hectoliters. Brie and Beauce oats are the varieties used.

For forage beets (mangolds) the average for 5 years (1884–'88) was 46,700 kilos per hectare, while for carrots it was 38,400 kilos. Permanent grass lands averaged 4,800 kilos per hectare for the first crop, cattle being allowed to graze upon the second. The first crop of lucern averaged 6,500 kilos, while the first and second crops of clover gave together 6,000 kilos.

Cattle.—During the spring and summer, and until about the middle of November, milch cows are allowed to graze, or are fed upon green fodder. In the winter they are housed and are given a daily ration of turnips and cabbage, with two rations daily of fermented beets, with chopped straw, lucern hay, ordinary meadow hay, bran, and oil cake. Maize from the silo is held in reserve for those times when green fodder runs short.

The production of milk averages 350 to 450 liters per day, from 60 Cotentin cows. An attempt was made some years ago to sell this milk at Tours, but this scheme having failed for commercial reasons, the milk has since been utilized in the making of butter and cheese at Thoriau, as above described. The calves find a ready sale to neighboring farmers or to butchers, a few being retained for breeding purposes.

The two farms together bring to their owner a yearly profit of about 40,000 francs ($8,000).

ENSILAGE.

The custom of preserving grain by means of burial in the ground is of extremely ancient origin. It was known to the Egyptians, and has been described by Pliny, Varro, and other Roman writers, and is still practiced in Italy and Spain and among the Kabyles of Algeria.

This system was the origin of the silo and of our modern system of ensilage, the two principal points of difference being, first, that the old system was used to preserve grain for human food, while

modern ensilage is to preserve green forage, roots, pomace, etc., for use for cattle; secondly, in the modern system pressure and the exclusion of air are essential features.

Ensilage as we now understand it was first attempted in 1852, at Burlin, in the Sologne, and an excellent description of the process, together with that of the experiments of M. Goffart, one of its principal promoters, has already been given by Commissioner Knight in the Report upon the Universal Exposition at Paris in 1878. (Vol. v, p. 243.)

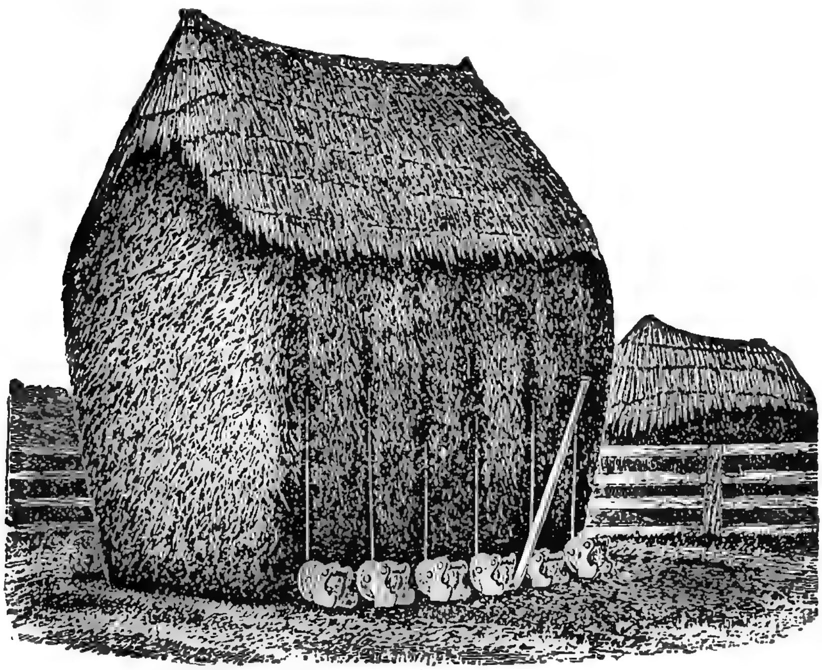


FIG. 25.—The Johnson system of ensilage.

It remains to add that since 1878 the system of ensilage generally adopted, which is that of Goffart, has undergone some rather important modifications. At first the modern silo consisted of a long rectangular or oval chamber, generally built of masonry, while its deviation from the ancient form was to be seen in the fact that from one-half to two-fifths of its depth was underground. It was found that this underground construction was not absolutely necessary, and it was therefore gradually abandoned, the whole silo being finally built above ground. Then the masonry, the expense of which was often found onerous, was given up, simple stacking under heavy weight being resorted to, and the stack thus formed being covered with a layer of earth.

Finally, in 1883, it was discovered both in France and in Massa-

chusetts that maize could be ensiled with perfect success in the open air, provided that sufficient pressure be used, since the air could not penetrate into the interior of the mass but for a very small distance.

Thus costly construction of silos has been done away with, and the only apparatus now necessary is one for compression of stacks of the matter to be ensiled, which may be built up in any open field, after the manner of an ordinary haystack.

The term ensilage is still used to designate this process, although all resemblance to the original excavation, or *silo*, has passed away. As a more appropriate name, the word *emmenlage*, from *menle* (a haystack) has been suggested.

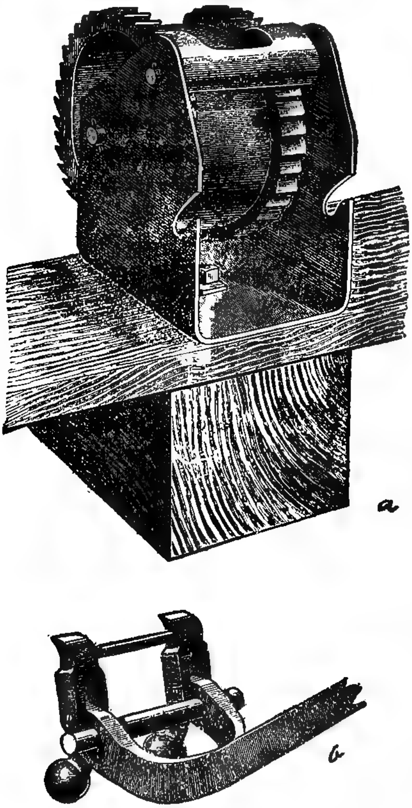


FIG. 26.—Details of the Johnson system of ensilage. *a*, ratchet; *b*, end of lever.

The principal system for the compression of ensilage in stacks which was to be seen at the Exposition was that of Mr. C. G. Johnson, and is the system now commonly in use in England. Its principle is very simple, being the compression of the stack by means of galvanized steel wires passed over the top and drawn taut by a system of cylinders or drums, provided with ratchets which are securely fastened to the beams which form the platform upon which the stack rests. The accompanying figures will make this clear at a glance. (Figs. 25 and 26.)

In order to construct a stack beams having a section of 6 by 9 inches are laid upon the ground about 3 feet apart, care being taken to have them long enough to extend for about 2 feet beyond the sides of the proposed stack. A flooring of plaster is laid upon these, and the cylinders with their ratchets are securely bolted in position upon the ends of the beams. The forage to be compressed is then piled upon the platform, the wires are placed over it, and drawn taut by the cylinders and ratchets which may be manipulated by a simple hand lever. Care is taken to apply the pressure gradually, generally only once a day, preferably in the evening, in order to avoid heating of the mass. As the mass shrinks new pressure is applied until it is found that no more is needed.

Stacks are generally built from 15 to 20 feet high, and may conveniently be covered by a straw thatch, though this is not absolutely necessary, and is to protect the wires rather than the contents of the stack. It is found that the forage decays only for a distance of 6 or 8 inches from the outside, the loss being about 2 or 3 per cent of the total weight, or not greater than in a silo constructed of masonry. A convenient system of ensilage for small lots is the Blunt automatic system, shown in Fig. 27. The forage may be fresh or partly dried, wet or dry, and is simply heaped together and the apparatus adjusted.

In addition to maize many other crops are used as ensilage in France, such as sorghum, rye, millet, colza, forage beets, turnips, cabbage, clover, rye grass, ordinary grasses, vetch, the leaves of sugar and forage beets, vine leaves, etc. Maize for ensilage should be cut when it is at its moment of greatest succulence, as should all other grasses and forage plants, generally when they are in full flower; cereals, however, should be cut for ensilage when their grain is in a milky state. Silos are filled at the time of cutting the crops, that is, from June to August for first crops, and toward the end of September or in October for second crops. They may be opened in the following December or January. It is said that in some parts of France, notably in Gascony, the peasants are strongly opposed to ensilage, and that progressive farmers have hard work to persuade them of its value.

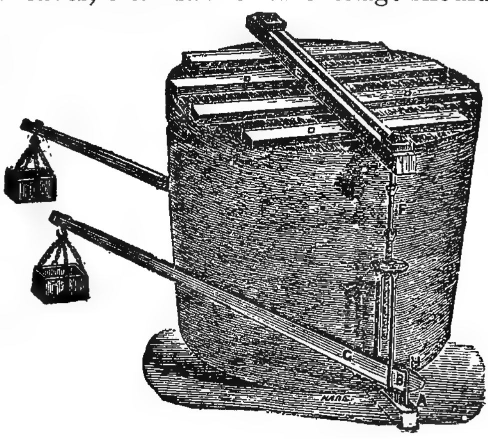


FIG. 27.—Blunt automatic system of ensilage.

HOPS.

A fine display of hops of excellent quality was made by the *Syndicat des Houblons de Bourgogne,* of Dijon. This useful syndicate was founded in 1887, and now numbers over 700 members. Its object is to further the interests of hop culture in Burgundy, as follows: By procuring the best material, implements, and fertilizers at reduced prices; by collecting and disseminating information concerning the crops, demand and supply, prices, etc.; and by facilitating the sale of hops raised by members of the syndicate; by affording counsel as to methods of cultivation, etc.; by encouraging the improvement of different varieties of the hop plant, and by upholding improved methods of cultivation, and organizing exhibitions,

lectures, etc. Especially does the syndicate endeavor to promote the appreciation of Burgundy hops, and to maintain their reputation. The efforts of the syndicate and the superiority of their products were rewarded at the Exposition by a gold medal.

The cultivation of the hop plant is not very ancient in Burgundy, having been introduced in 1832. The first crops proved to be of excellent quality, so that they became much sought for by brewers.

This cultivation now occupies 1,400 hectares in the Department of Côte d'Or, and the annual yield is from 30,000 to 35,000 quintals. The plantations are upon argillo-calcareous soils.

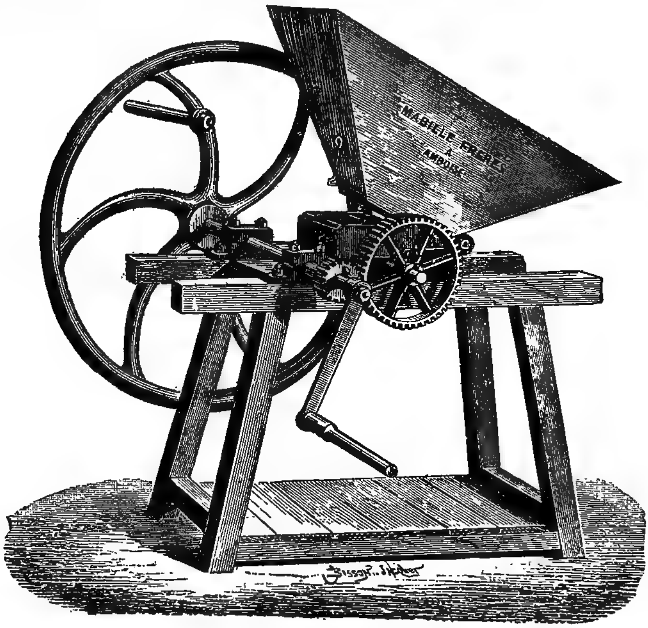


FIG. 28.—Ordinary French apple-crusher, Mabille Frères, Amboise.

CIDER APPLIANCES.

A very complete account of cider manufacture in France and in England is given in No. 106½ of the reports of the consuls of the United States, issued during the Exposition, in July, 1889. This contains full details concerning varieties of cider apples, and of ordinary methods of cider-making, besides a description of the diffusion process, and illustrations of cider-presses, apple-crushers, cider-making plant, etc.

Beyond several models of presses and apple-crushers, and samples of cider from Normandy and other parts of France, the Exposition did not offer anything of extraordinary interest pertaining to this industry, so that there is but little to add to the above consular report.

Some of the apparatus however, is worthy of mention. A good sample of the ordinary type of apple-crushing machine with toothed rollers, is shown at Fig. 28, and was among the latest models exhibited. MM. Simon & Sons, of Cherbourg, showed a crushing machine (Fig. 29) constructed upon a new principle, namely, that the apples are not broken up by toothed rollers as in the former machine, but are regularly crushed by a continuous and increasing pressure, just as quartz rock is broken in the well-known "jaw crushers." This machine has a single cylinder, provided with movable blades, which play alternately in and out of the cylinder as it revolves, and serve to sweep the apples into a space between the cylinder and a toothed jaw tangential to it. This jaw is articulated and may be set at any desired distance from the cylinder, thus regulating the degree of crushing. Should any hard substance, for instance, a

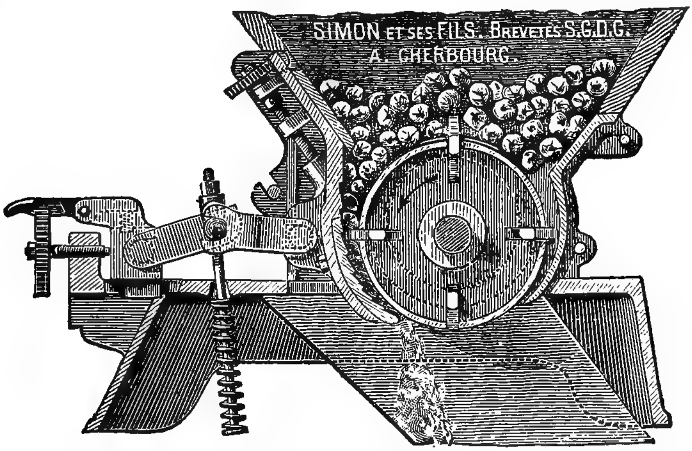


FIG. 29.—New rotary apple-crusher, Simon & Sons, Cherbourg.

large stone have fallen into the hopper with the apples, the jaw will, upon meeting it, simply fall back and allow the stone to pass through without injuring the machine, and will then resume its former position.

A distributor, not shown in the illustration, is also provided, by which the supply of apples may be regulated. It is claimed that this machine regularly grinds the apples, instead of merely cutting them as formerly, that the quantity of work done may be easily regulated, that the machine is not easily choked, but will clear itself, and that there is but little danger of its breaking. The machine may be worked by hand, horse-power or steam-power, and in the latter case may run at the rate of one hundred to one hundred and twenty revolutions per minute.

Cider Presses.—These were partly exhibited in class 49 and partly in class 74. Many cider presses are equally useful as wine presses,

and as such were to be found exhibited under class 75. Many also may be used with equal facility for olive-oil extracting. All these, with but one or two exceptions, are constructed upon the same plan, and differ only in the details of the ratchet, lever, and screw by which they are worked. It has therefore been found advisable to describe them once for all under class 74 instead of dividing them.

The accompanying illustration of a "Universal perfected press" (Fig. 30), constructed by MM. Mabille Frères, of Amboise (Indre-et-Loire), gives a good idea of the ordinary construction of a French cider or wine press. The essential parts are the bottom, stoutly con-

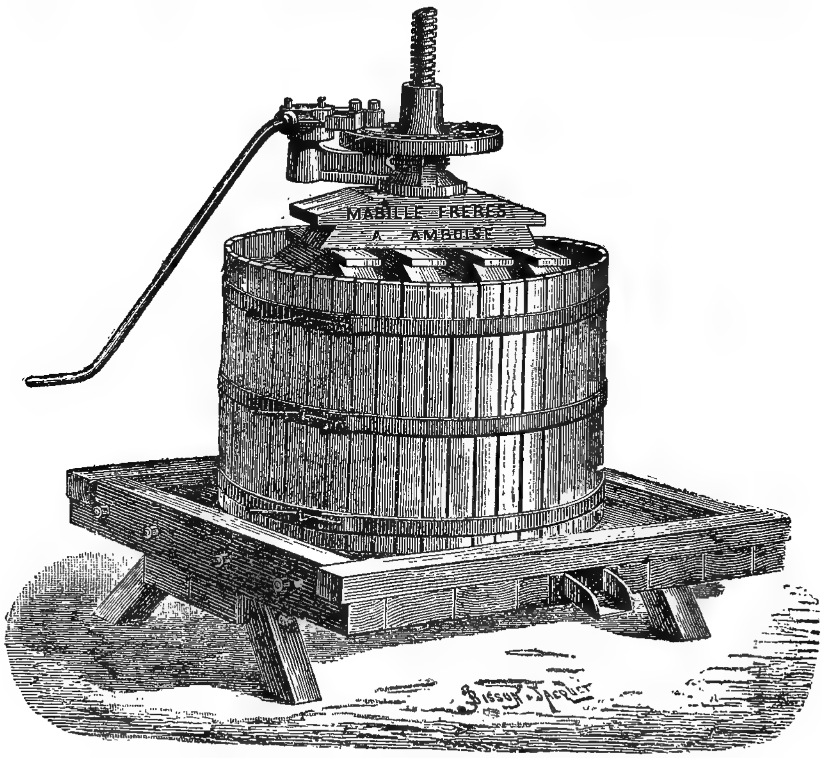


FIG. 30.—Ordinary French cider or wine press. Mabille Frères, Amboise.

structed of beams of wood, and so made as to form a trough for the reception of the liquid, and the top or cover, consisting of a strong wooden platform. A stout perpendicular screw is fixed in the center of the bottom, and the cover is moved downward along this by means of a ratchet and lever worked by hand. The other parts of the press are not essential. Generally there is a cylinder of wooden staves, placed not close together, but with a very small space between them and bound in place by strong iron hoops, but this cylinder is often omitted, as in Fig. 31. The bottom of the press is some-

times of iron, and the whole apparatus is often mounted upon wheels, as in Fig. 32.

It is rather in the way of the ratchet and lever that improvements are made in these presses. One of the best of these is that of MM. Mabille Frères, well described in the report of 1878.

Another device of this sort was that shown by M. J. Ollaguier, of Tours, and called the "Universal Parallelogram" press. The mechanism of this device (Figs. 33 and 34) consists of two handles or radii, D A and D C, turning about the socket D as a pivot. This socket and the plate E are cast in one piece. These two radii are provided with keys, M N, which set the machine in motion. K and S are two gudgeons of steel which fasten to the radii two iron cranks, P and

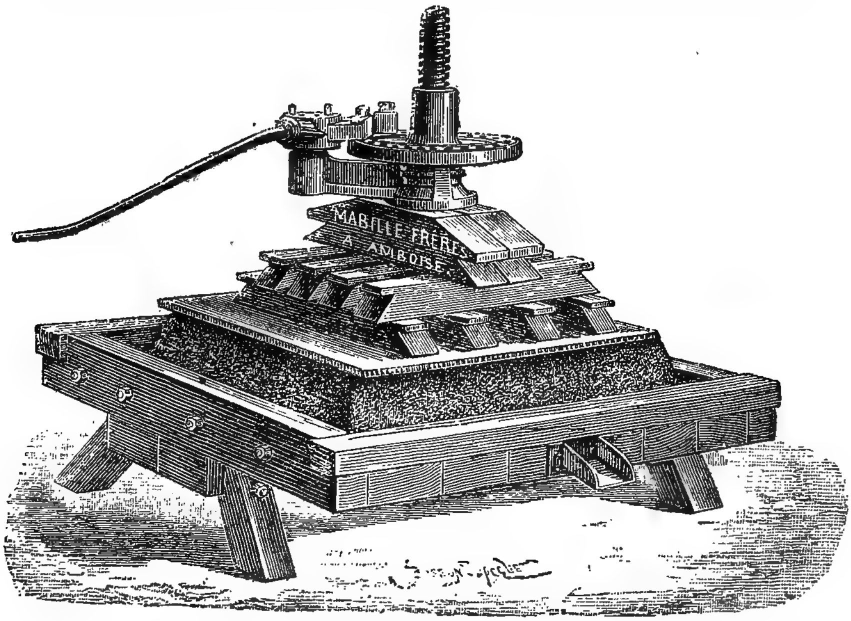


FIG. 31—Cider press without cylinder. Mabille Frères, Amboise.

R, only the latter of which is jointed at X. These two cranks join at Z in a single axis at the head of the lever socket H, which has the line E B as an axis of rotation. Thus the play of the parallelogram M D N Z is at once evident. The keys at M push in the direction of the arrow 1 while those at N become disengaged, while upon moving the lever in the reverse direction those at N push in turn in the same direction, arrow 2, while the key at M are liberated, and the continual rotary motion of the plate E is kept up in the direction of the two arrows. Besides this any tendency toward the bending of the central screw (as often happens in cider and wine presses) from force applied at M is immediately counteracted by a similar force at N;

there is, therefore, equilibrium, and the screw escapes bending. The weight of the lever socket H is carried upon a casting which descends the screw with the rest of the apparatus.

In order to obtain the greatest speed upon commencing the pressing of a batch of apple pulp, etc., the pin Z is taken out and the lever socket H is removed. The lever is then inserted in the socket A and the plate E is revolved directly. When, as the pressing goes on, greater force and less speed are required, the socket H may be

FIG. 32.—Cider press with iron trough, and mounted upon wheels. Mabille Frères, Amboise.

replaced and the apparatus worked as above described. It is claimed by the inventor that this system yields 60 per cent of the theoretical pressure, a result rarely obtained by other systems.

A new and ingenious model of a cider or wine press was exhibited by M. Emile Servais, of Weilerbach, Grand Duchy of Luxemburg (Fig. 35). In this press the central screw is entirely done away with. Two cylinders, composed of staves set some little distance apart, are

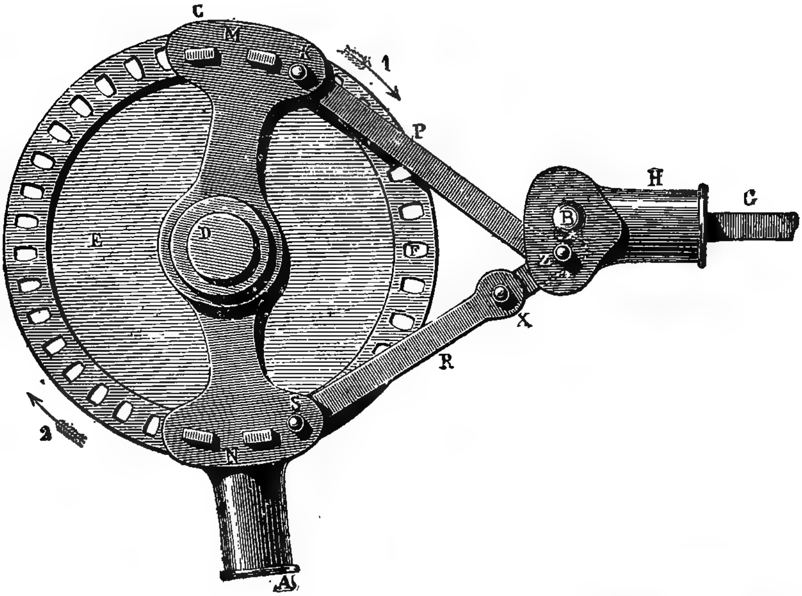


FIG. 33.—Mechanism of universal parallelogram press. Ollaguier, Tours.

placed eccentrically one within the other, and each revolves upon its own axis. The outer cylinder is moved by hand power, while the inner one does not receive its motion from this power, but from the friction of the apple pomace or grapes which are operated upon. These are introduced into the broadest part of the space between the two cylinders, and are gradually subjected to increasing pressure as they are forced along this constantly narrowing space. By this means great pressure is given to a thin layer of substance, so that the pomace or marc, when it has passed through the narrowest space and into the broader space beyond, is nearly dry. The pomace there meets a sort of guide or rake, shaped like the mold-board of a plow, which conducts it out ofthe machine, so that a continuous supply may be operated upon.

The distance between the sides of the two cylinders may be increased or decreased at pleasure, and the

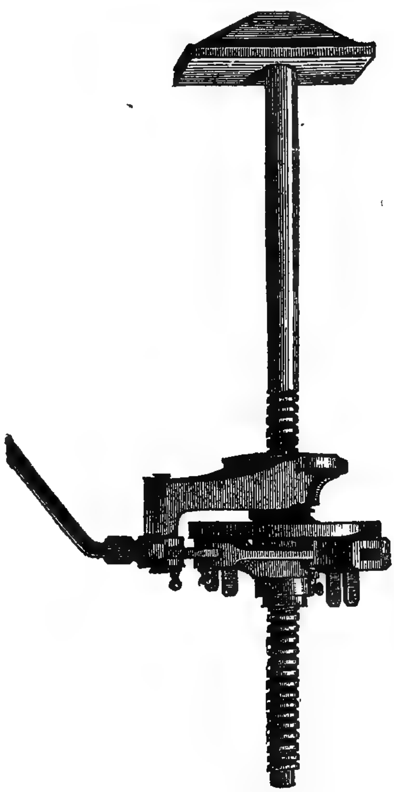


FIG. 34.—Mechanism of universal parallelogram press. Ollaguier, Tours.

press has the advantage that a less thickness of pomace or marc receives the pressure, so that but a very small portion of juice is left in it, an advantage which the ordinary form of press does not possess. The principle is similar to that of the jaw crusher. With this press about 1,200 gallons of grape juice may be extracted in a day by manual power, or from four to six times as much as by horse power.

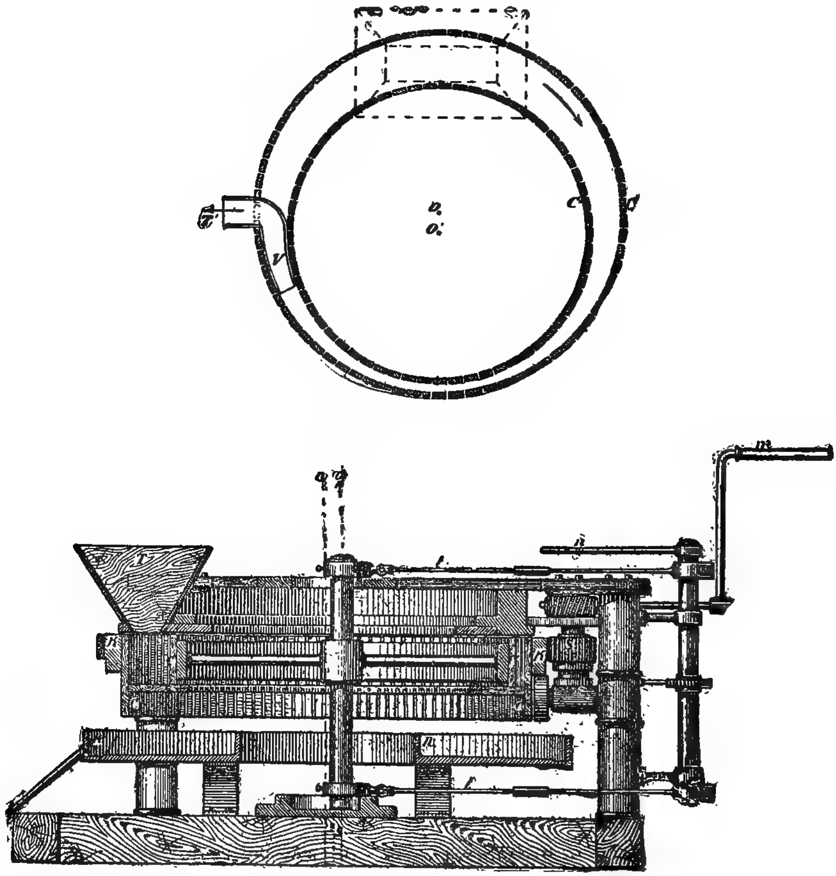


FIG. 35.—New rotary cider or wine press. Emile Servais, Luxemburg.

The new continuous press of MM. Simon & Sons (Fig. 36) depends upon the same principle as the Servais press, but is much more compact in form, and may be worked by steam power. It consists of two cylinders, one within the other, the outer one, or vat, receiving the fruit, and being perforated to allow the escape of the juice. The interior cylinder serves to press the fruit against the inner walls of the exterior one. Above the cylinders is a hopper with a rotary distributor, and to the right of this, within the larger cylinder is a collector which gathers up the exhausted marc and forces it through

the exterior spout, thus affording room for fresh fruit and making the process continuous. Pomace or marc being passed but once through this pressure yields 65 per cent of its juice, while a triple pressing brings this figure up to 75 or 80 per cent.

The presses of M. Cassan Fils of Bourgoin (Isère), are provided with a hydraulic apparatus also described in 1878. (See Report 1878, Vol. v, p. 230.)

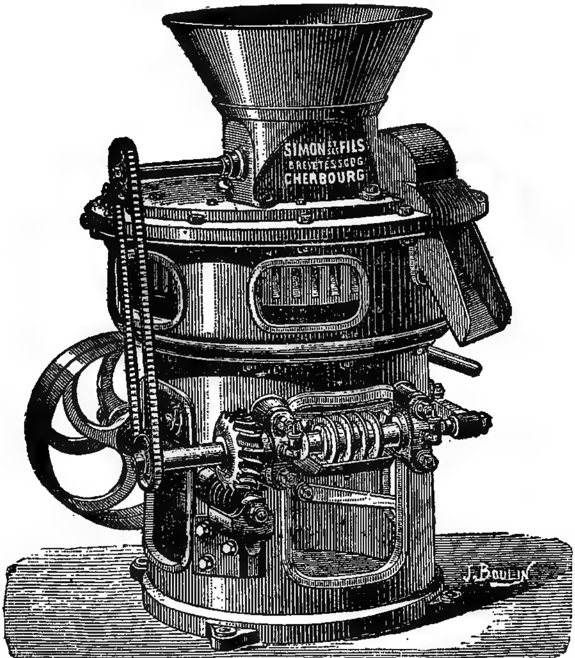


FIG. 36.—New continuous cider press. Simon & Sons, Cherbourg.

PRESSES, ETC., FOR OLIVE OIL.

Many of the above cider and wine presses are also applicable for use in extracting olive oil, but in some cases presses of special construction are used, one or two of which may be described.

A press made by MM. Mabille Frères (Fig. 37), is supported upon four cast-iron columns. The screw is not fixed as in the cider presses but works downward upon the charge, being moved by a series of cogwheels, power being applied by hand or steam.

A press of similar but simpler construction was exhibited by M. Marmoumier Fils, of Lyons. It is worked like an ordinary cider press, by a ratchet and lever, but these are so arranged that the speed of working may be instantly accelerated so that the olive pulp may be pressed before it has time to cool. The press is supported

upon three columns only, thus affording lighter construction, without any loss of strength, while the base is enlarged to catch any water which may be thrown out during the operation.

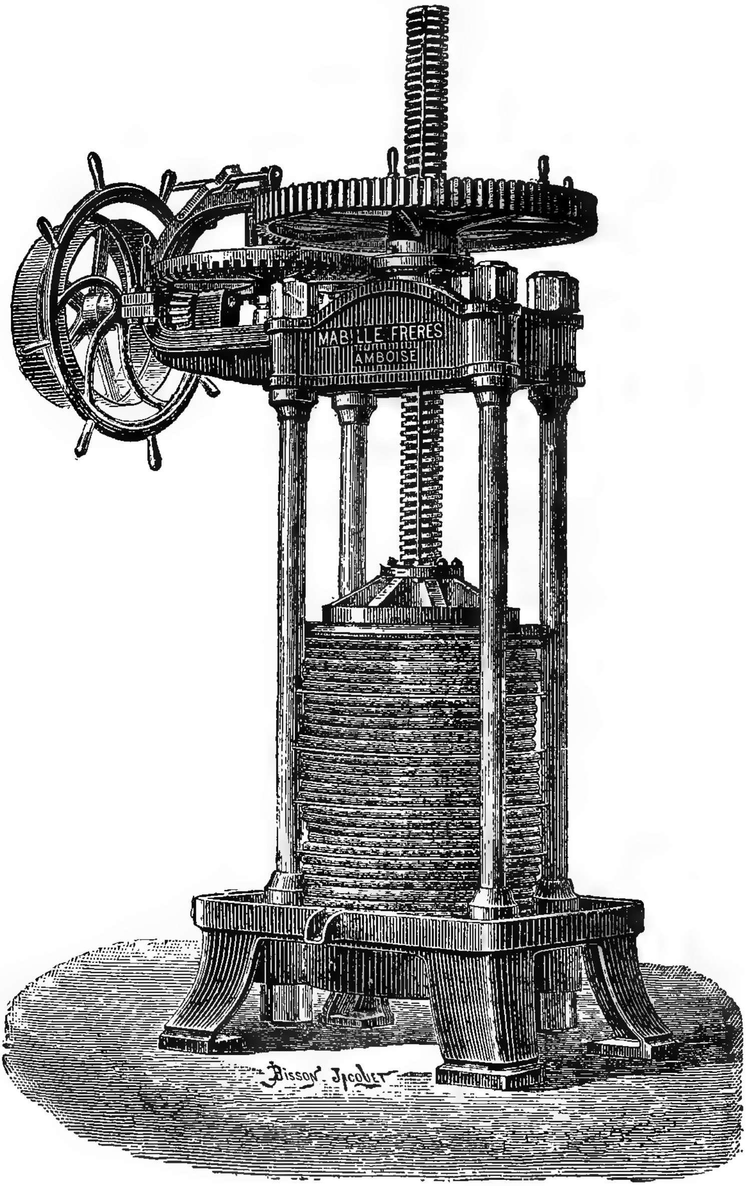


Fig. 37.—Olive-oil press. Mabille Frères, Amboise.

Several designs of mills for crushing olives were exhibited. One of these, by MM. Mabille Frères, is shown in Fig. 38, and is all of

iron, and may be worked by direct horse-power. A very simple olive mill, moved by horse-power and having a large stone roller, was shown by M. Marmoumier (Fig. 39).

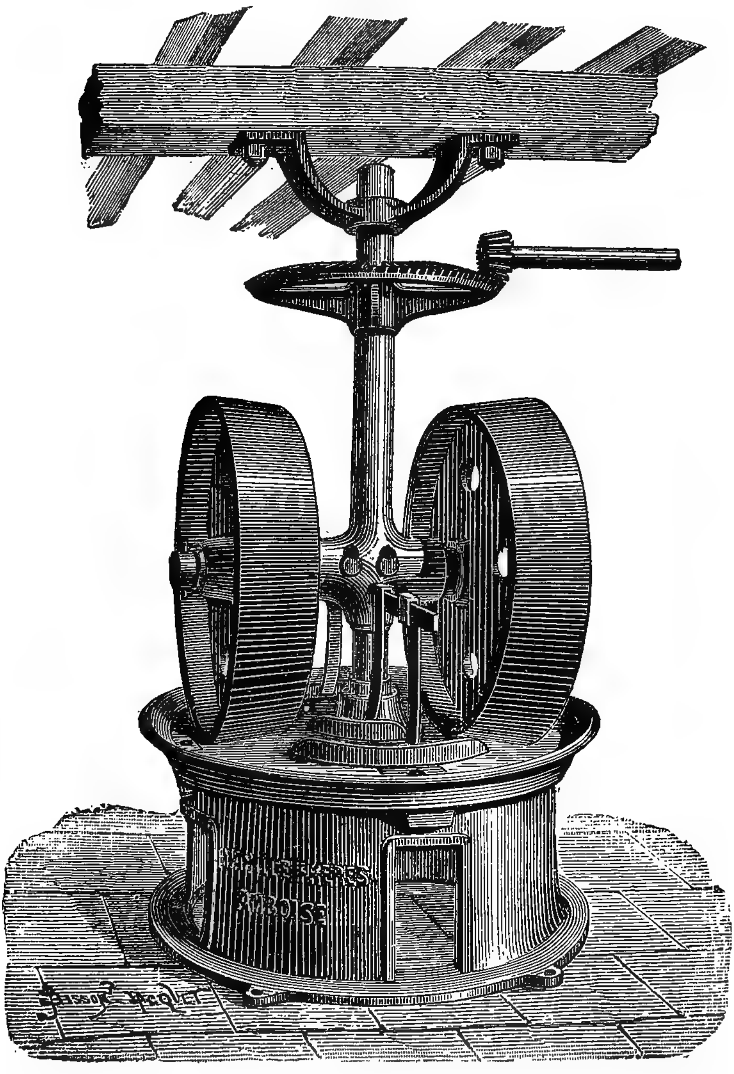


FIG. 38.—Mill for crushing olives. Mabille Frères, Amboise.

DAIRY APPLIANCES.

The dairy interest was well represented at the Exposition, for, in addition to the cattle show and to the temporary and permanent exhibits of milk, butter, and cheese in class 69, there were in class 74 several good displays of dairy machinery and appliances, and at

two of the largest of these (those of the London and Provincial Dairy Company and of Mr. Th. Pilter) opportunity was given for seeing such appliances daily in actual operation.

A competitive trial was also held upon the Esplanade des Invalides, July 17 and 18, at which every machine of importance was tested before the jury. For convenience the machines were divided into eleven categories, as follows:

1. Milk mixers.
2. Apparatus for heating milk.
3. Apparatus for cooling milk.
4. Cream raisers.
5. Mechanical separators.
6. Churns.
7. Buttermilk separators.
8. Butter mixers.
9. Butter presses.
10. Apparatus for cheese-making.
11. Miscellaneous.

No machines of great novelty were presented, those shown being rather of the nature of recent improvements upon well-known types.

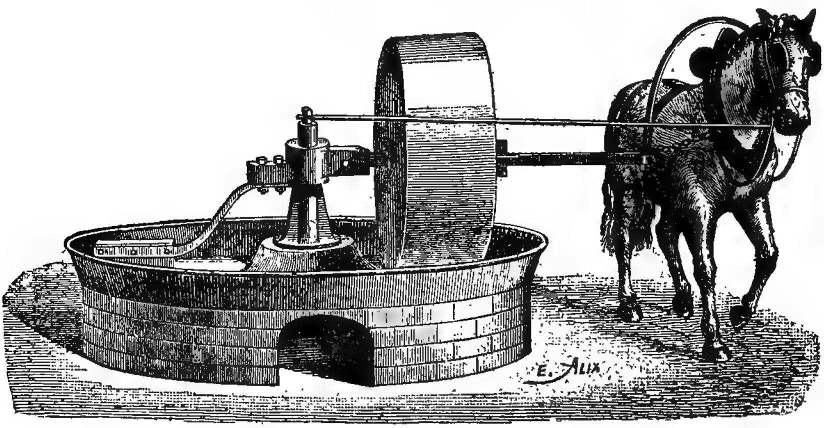


FIG. 39.—Stone roller, moved by horse-power, for crushing olives. Marmoumier.

1, 2. *Milk Mixers and Heating Apparatus.*—Nothing of especial merit was shown in either of these two categories.

3. *Apparatus for cooling Milk.*—Several of these were shown. In the cooler invented by M. Chapellier, of Ernée (Mayenne) (Fig. 40), the milk is cooled by being passed downward from a receptacle, A, over a corrugated-zinc box, B, which is hollow, and is kept cool by an ascending current of cold water, F E, in its interior. The milk falls from B to F and is drawn off at C, the rapidity of its flow being regulated by the inclination of the corrugated surface. Milk which has a temperature of 32° to 34° C. (89° to 93° F.) when drawn from the cow may thus be cooled in a few minutes to within 2° of the temperature of the water used, and is thus preserved in its normal state, and lactic fermentation is prevented. By using hot water the apparatus may be converted into a heater.

In a cooler made by M. Drouot, Boulogne-sur-Seine, the cold

water circulates upward through a closely wound spiral tube, the milk falling along the outside of the tube. It is claimed that this apparatus needs but little water, which would be of advantage upon certain farms.

4. *Cream Raisers.*—Chapellier's "Cold ventilating cream raiser," consists of a hollow box or table provided with a tightly fitting cover and with two lateral openings. The milk is placed in earthen pots or jars in the table, the cover is closed, and the air is allowed to circulate through the lateral openings, which are provided with metal or, better, silk screens to keep out dust, etc.

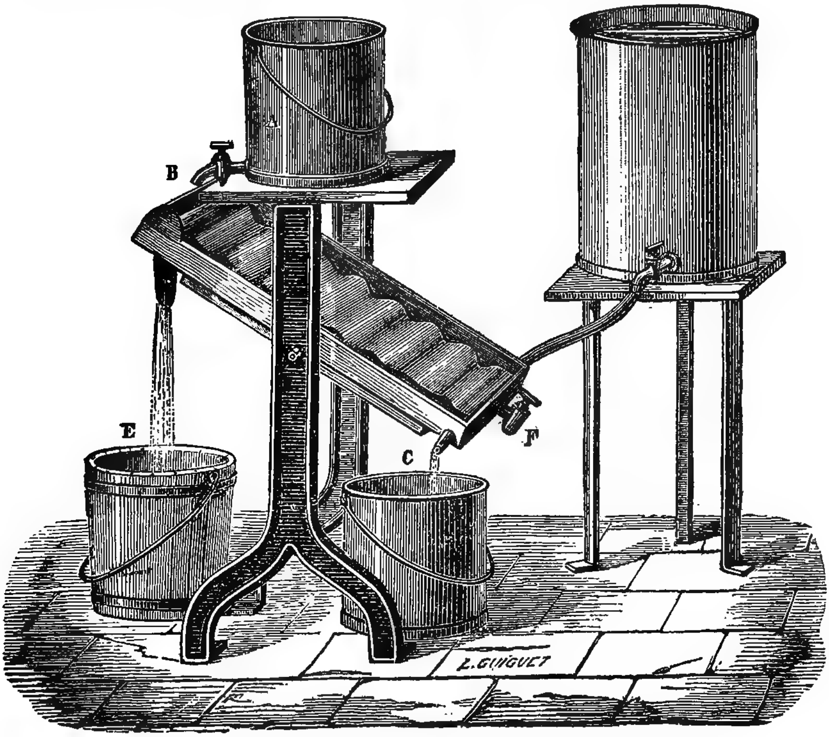


FIG. 40.—Apparatus for cooling milk. Chapellier, Ernée.

The current of air is produced by a system of wooden chimneys and passes over the surface of the milk in the pans, which are not covered. In from twelve to fifteen hours all the cream has risen and the milk has lost nothing of its normal state or its natural aroma, and there has been no fermentation. This apparatus is made to treat from 25 to 150 liters at a time.

The Herweg apparatus is a modification of the old apparatus of Girard, and consists of three vessels of the form of a truncated pyramid, into which the morning, noon, and evening milk are respectively placed. These vessels are then cooled in a large zinc trough through

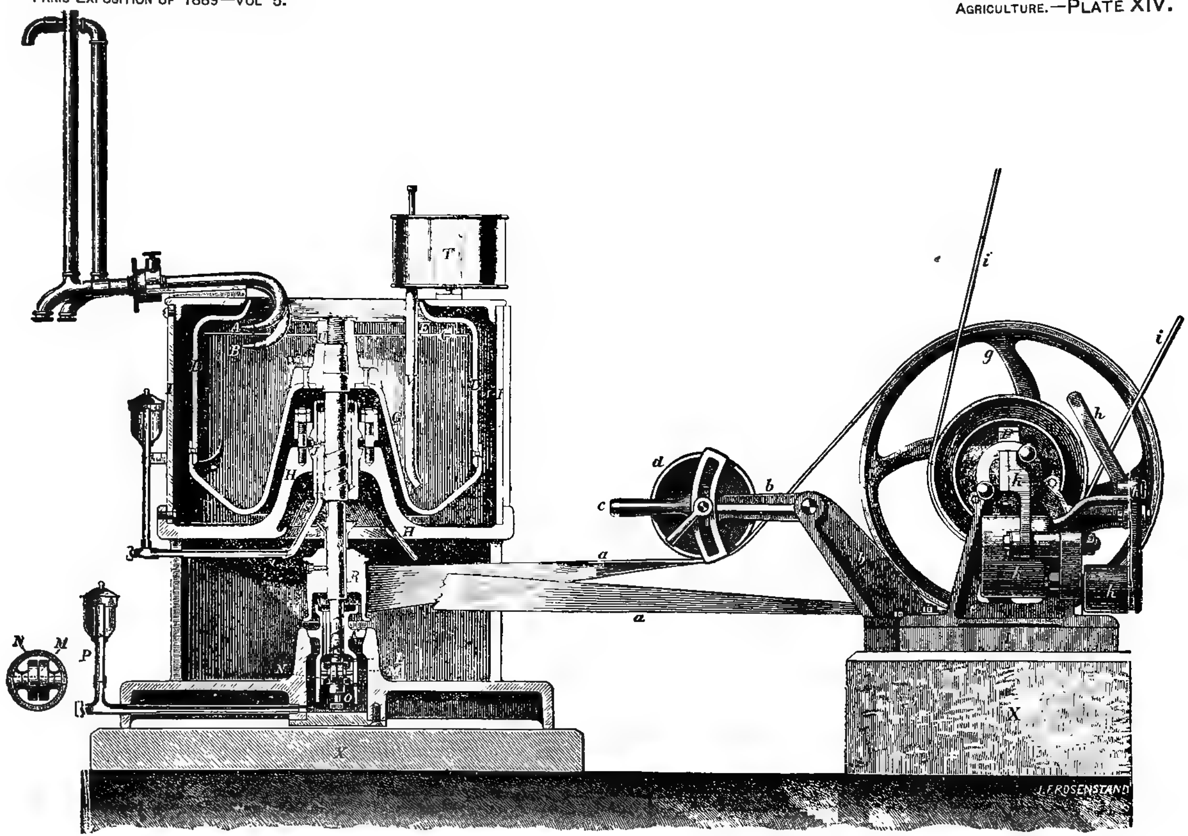
which cold water circulates. Several cream-raisers, of the Cooley type, were shown, and also the "Speedwell" method of skimming.

5. *Mechanical Separators.*—Several of these, all of the centrifugal type, were shown at the competitive trial. Especially noticeable was the new *AA* separator of Messrs. Burmeister & Wain, of Denmark. Pl. XIV. The upper part of the cylinder of this machine is divided into two parts by a circular plate, C. When the machine is in motion, the milk, being driven by centrifugal force to the outside of the liquid mass, ascends the walls of the cylinder D, flows over the plate and is carried away by the tube A, while the cream is drawn off at B, underneath the plate. The two tubes, A and B, are movable, and can be adjusted at will without stopping the machine, thus allowing the cream to be obtained at any desired degree of concentration. The supply of milk can also be similarly regulated, and these two advantages are possessed by no other separator. This machine will produce a kilogram of butter from an average of 24 liters of milk, which is from 10 to 20 per cent more butter than can be produced by any other system. The makers also claim that this model is 50 per cent better than their model of 1888, and that without increase in price, motive force, or speed. The machine moves at the rate of 2,700 revolutions per minute, and will separate 950 to 1,000 liters of milk in an hour, at a temperature of 25° C. (77° F.), leaving but 0.192 per cent of fatty matter in the skim milk. The cost of this machine is about $300.

The smaller, or *B* model, made by the same firm, revolves 4,000 times per minute, and separates 500 to 525 liters an hour, at the same temperature, leaving 0.220 per cent of fatty matters. By this machine milk may be separated at any desired temperature and complete purification from foreign matters may be made. The cylindrical form is also an advantage over the usual bowl shape. An advantage is also found in using a flat instead of a round belt, the former not being so liable to slip as the latter. It is said that in Denmark 2,000 of them are in use, there being only 500 of all other systems.

Two important adjuncts were exhibited in the *AA* separator. The first of these was the automatic regulator, patented by M. J. Jönsson, by means of which, when the motion becomes too fast, the belt *ii* is immediately pushed over upon the loose pulley, or "idlex," and a warning bell is rung. The other contrivance is the apparatus devised by Prof. Fjord, for rapidly ascertaining the richness in cream of the milk furnished by different farmers.

A system of installation for a dairy, with Burmeister and Wain separator, was also shown. A separator made according to a new model is the "Alexandra" (Fig. 41), manufactured by Messrs. Koeford & Hanberg, of Copenhagen, and in general use among the Danish coöperative dairies. In this machine the spindle has a spherical top,



NEW SEPARATOR OF BURMEISTER & WAIN, WITH THE JÖNSSON REGULATOR.

upon which the cylinder is perfectly balanced, being moved by friction. This self-centration enables high speed to be maintained without the slightest vibration, and thus renders expensive foundations unnecessary. Besides this, the cylinder is loose and may be easily removed for cleaning.

Specimens of the Laval machines, moved both by hand and steam power, were shown by Mr. Pilter. Nothing particularly novel was noticeable in these, though they were well made machines of their kind, except in one machine (Fig. 42), which is moved by direct action of steam from a supply pipe without intervention of a steam engine.

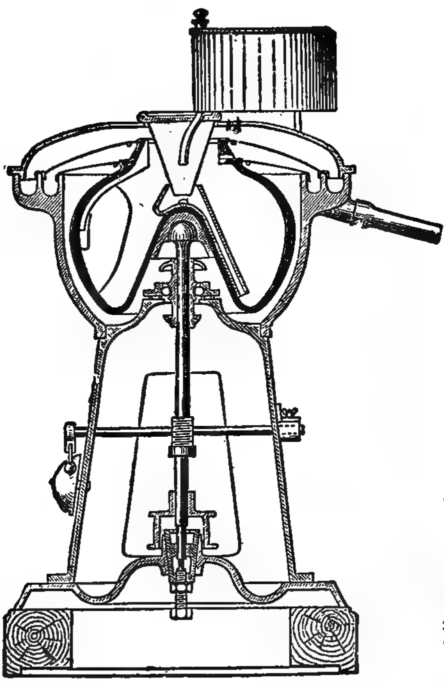


FIG. 41.—The Alexandra cream separator.

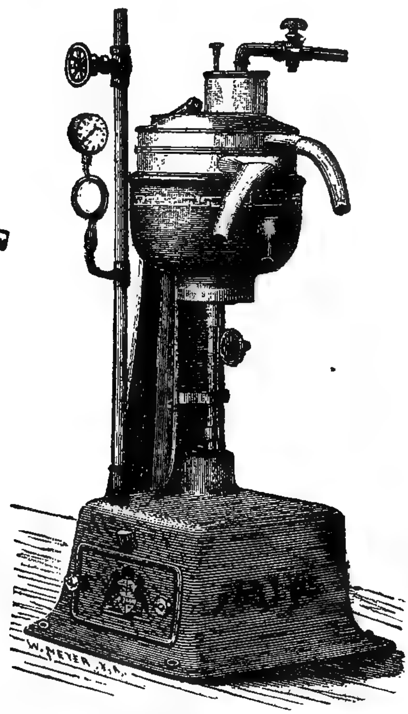


FIG. 42.—Centrifugal separator, moved by direct application of steam.

6. *Churns.*—The churns shown by M. Chapellier were all made of the best oak wood, and were of several sizes, to be worked by hand or by horse power. They were polyhedral in form, but did not present any particularly new characteristics. A churn of the Danish type, exhibited by Mr. Pilter, is shown at Fig. 43. It may be worked by steam power, and revolves upon trunnions. This churn is advantageous through its simplicity, its portableness, and the facility with which it may be taken apart and cleaned.

A churn, exhibited by A. Baquet, was barrel-shaped, and revolved upon an inclined axis. The "Speedwell" churn, shown by the

London and Provincial Dairy Company, consists of one or more glass cylinders, closed by screw covers, and placed in a wooden frame revolving about a horizontal axis, turned by hand. This churn is especially useful for trying small quantities of milk from different sources, or for observing the phases of churning. A model for use at the table was shown. The Hathaway churn, exhibited by the same company, is barrel-shaped, upon an oblique axis; the interior is free, having no dashers, and one head of the barrel, fastened by screws, forms the opening.

FIG. 43.—Danish type of churn. Th. Pilter, Paris.

"The Charlemont Diaphragm Churn," made by Messrs. Thomas Bradford & Co., of Salford, England, may be used with or without dashers (Fig. 44), and is a favorite churn in England.

MM. Japy Frères exhibited a sheet-iron churn, having a double envelope in order to preserve a constant temperature in the cream. Finally MM. Simon & Sons, of Cherbourg, displayed several forms of barrel-shaped churns, worked by hand or by horse power. Their newest form of churn is cylindrical, with all its interior angles rounded off. It is also provided with a system of cones in the place of cogs for transmission of power. (Fig. 45). By the movement of a small lever these cones may be so inclined to each other as to regulate

the speed of the churn at will from 30 to 55 revolutions per minute, without altering the speed of the horse power. By means of a small

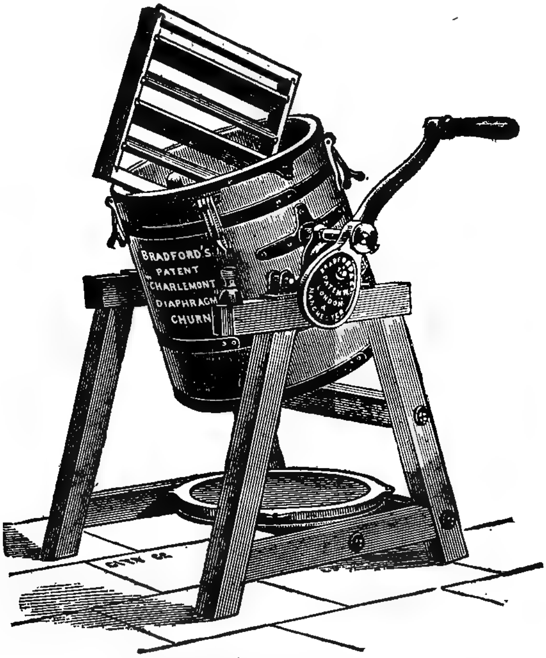


FIG. 44.—The Charlemont diaphragm churn.

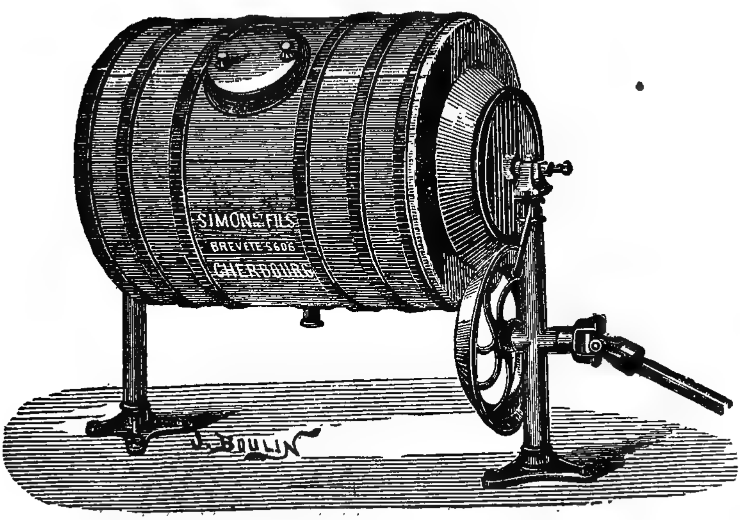


FIG. 45.—Churn with system of cones. Simon & Sons, Cherbourg.

bent tube placed in the trunnion of the churn the interior gases may be allowed to escape, while samples of the cream or buttermilk may

be taken at any time without stopping the churn. A special low-lying horse-power is made for churns by this firm.

8. *Buttermilk Separators.*—But one of these machines was shown at the trial, that of Mr. Pilter. By means of this machine, when hand power alone is used, 4 to 5 kilos of butter may be completely freed from buttermilk in 5 minutes, and may even be sold without further manipulation. Another model, moved by steam engine, was also exhibited, but was not produced at the trial.

8. *Butter-workers* (*Malaxeurs*).—There was nothing of special novelty in the three rotary mixers with horizontal tables, which were exhibited.

M. A. Hubert, of Saumur, showed a revolving mixer (Fig. 46) moved by steam power, and especially designed for mixing hard with soft butters and producing a perfectly homogeneous mass.

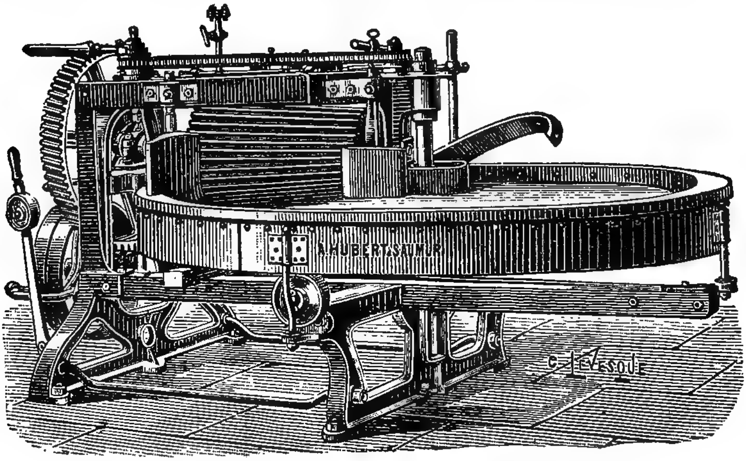


FIG. 46.—Revolving butter-worker. A. Hubert, Saumur.

The "Albany butter-worker," made by Messrs. Bradford, is a compact but powerful machine, consisting of a fluted roller working in a galvanized iron frame, which also incloses both the horizontal and vertical friction rollers. MM. Simon & Sons displayed two mixers, one horizontal and one vertical. In the former (Fig. 47) the distance of the roller from the rotary table may be easily adjusted by a small handle; the roller always remains parallel to the table. In their vertical mixer (Fig. 48) salt may be perfectly combined with the butter or butters of different qualities may be mixed. These two machines are intended for use in large factories.

9. *Butter Press.*—Only one model was shown, that of Mr. Pilter. This press turns out 300 lumps of butter, each weighing 500 grams or less per hour.

10. *Apparatus for Cheese-making.*—M. L. Douillard, of Fontenay-le-Comte (Vendée), exhibited an apparatus for boiling the milk used

n making hand cheeses. This consists of a vertical boiler of copper to heat the water, and of a cylinder of tinned copper with a false bottom of sheet iron, the exterior of which is protected by a wooden casing. There is also a stirrer inside the cylinder, and a hot-water pump. The milk being placed in the cylinder the hot water is pumped into the false bottom and the milk is boiled without the risk of burning; when the rennet is added the curd is broken up by means of the stirrer, and when the whole operation is finished the hot water may be returned by the pump to the boiler and be used over again.

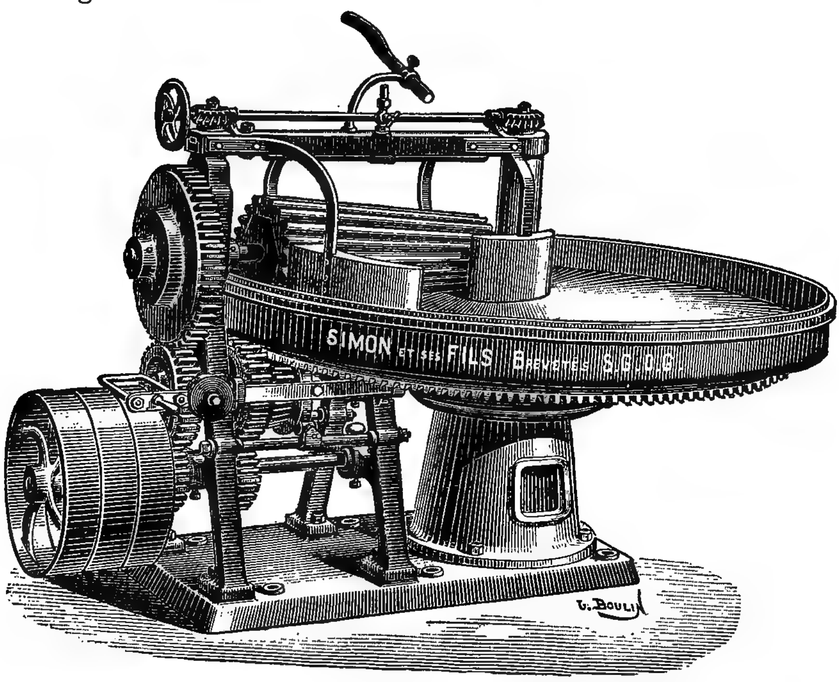


FIG. 47.—Horizontal butter-worker. Simon & Sons, Cherbourg.

The London and Provincial Dairy Company exhibited cheese presses and the apparatus of Messrs. Pond & Son, of Blandford, England, especially designed for Cheddar cheeses.

11. *Miscellaneous Apparatus.*—M. Regnault Renaux exhibited milk pails of sheet iron made without seams, soldering, or rivets, and with all interior angles rounded, thus giving no place for milk to collect and cause trouble.

M. Drount showed an ingenious siphon consisting of a simple bent tube provided with a stopcock at one end and a valve at the other, so that when taken from the liquid it always remains full.

M. Souchu-Pinet, of Langeais, exhibited several forms of receptacles for fresh milk from which the milk may be separated from the cream by siphons. In the first of these the vessels, of strong tinned

iron, are placed one above the other in stages, and are provided with simple rubber tubes by way of siphons and spaces underneath for cold water. The second is of similar construction but without water spaces. The third consists of a wooden box containing a zinc basin for cold water into which the tinned iron vessels containing the milk are set.

The London and Provincial Dairy Company exhibited a milk hoist made by E. S. Hindley, of Bourton. By this cans arriving at the dairy may be raised to any desired height and the milk automatically poured into a receiver, thus saving time and labor. From the same inventor came also a centrifugal milk pump for raising skim milk after it has left the separator.

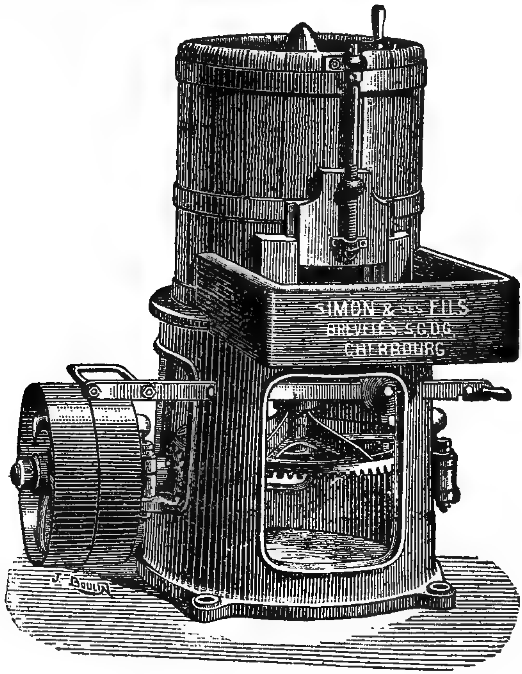


FIG. 48.—Vertical butter-worker. Simon & Sons, Cherbourg.

The Caison cheese press was also exhibited by Mr. Pilter. Its simple construction makes it a favorite in England.

The *Lactocrite*, an invention of M. de Laval, is an apparatus for the determination of the richness of a milk in fatty matters. The milk is mixed with an equal volume of acetic acid, forming a nearly colorless liquid containing the casein in solution in the acid and the fatty matters in suspension. If this liquid be subjected to rapid centrifugal motion by means of the lactocrite the fatty matters are separated from the solution and may be collected and weighed or examined. A dozen samples of milk may thus be examined in half an hour.

APPLIANCES FOR AVICULTURE.

These were shown in great variety at the Exposition and consisted of incubators, foster-mothers, and other appliances for the hatching of eggs and rearing of young poultry of all sorts. There were also poultry houses, dove cots, cages, and other accessories, and finally an exhibit of apparatus for fattening poultry for the market.

Incubators.—The "Incomparable" incubator (Fig. 49) exhibited by M. Bouchereaux, of Choisy-le-Roi (Seine), was awarded a gold medal. It is provided with a thermo-siphon, electric thermometer

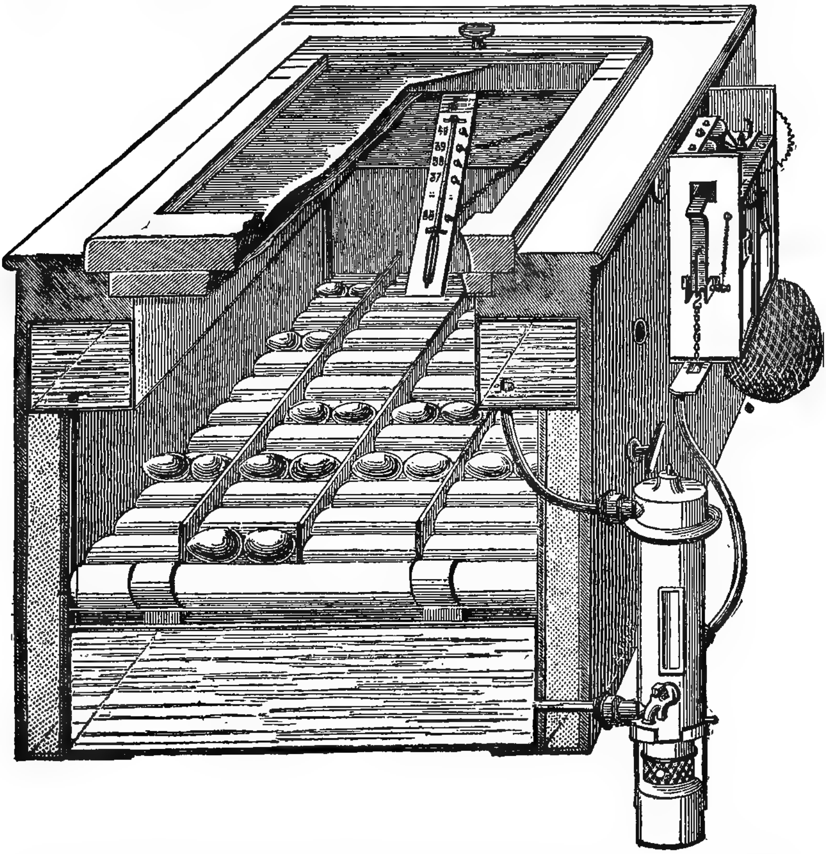


FIG. 49.—The "Incomparable" incubator, exhibited by M. Bouchereaux, of Choisy-le-Roi (Seine).

indicator and extinguisher, and an apparatus for turning the eggs, while a drying chamber, foster mother, and park may be easily attached. It is made in three different sizes, for 54, 104, and 210 eggs, respectively, the price of the largest size being 316 francs ($63.20). No especially new principle, however, was shown among the incubators, but practical illustration was plentifully given, for from the very first day upon which the Exposition was opened a supply of

hatching eggs, young chickens of all stages of growth, and even of young ducks and partridges, was kept up, and attracted considerable attention.

A simple device for turning the eggs in an incubator was shown by M. Phillippe Fils, of Houdan (Seine-et-Oise) (Fig. 50). The bottom of the drawer is of perforated sheet iron, upon which is laid a piece of cloth, fixed upon rollers at either side; the eggs are to be placed in rows separated by rods, and upon rolling or unrolling the cloth by means of an exterior button the eggs are gently turned without danger of breaking. The same exhibitor showed a very useful and cheap form of coop made of osier and also osier nests for hens and pigeons.

Another form of apparatus for turning eggs was shown by M. Fremond, of Paris. The eggs are placed in sheet-iron trays, four of which fill a drawer of the incubator. These drawers have bottoms perforated with holes rather smaller than the oval section of an egg, so that the eggs come in contact with the bottom of the drawer,

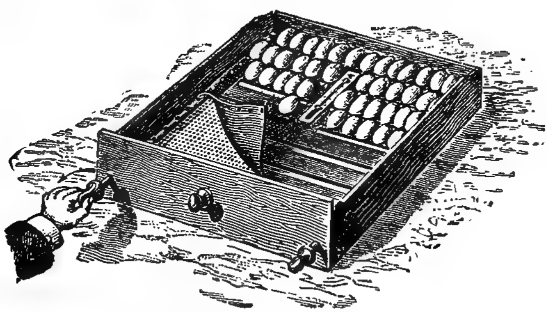


FIG. 50.—Apparatus for turning eggs.

which is of wire matting. To turn the eggs, one of the trays i removed and the other three are changed about in place, their exterior corners now being placed at the center of the drawer, the friction of sliding the drawer causing the eggs to turn and the first drawer being placed in the space left vacant.

The same exhibitor showed an incubator designed for the hatching of ostrich eggs, one size being large enough to hold 24 eggs. It did not seem to present any advantages over the Petaluma incubator now used for this purpose in California. (See Report U. S. Department of Agriculture, for 1888, p. 689.)

Artificial fattening is quite commonly practiced in France, and several different models of apparatus or *Gaveuses* for this purpose were upon exhibition.

These apparatuses are all upon the same principle, and that shown by M. Phillippe Fils (Fig. 51) will serve as a type. A reservior containing a liquid farinaceous paste (generally made from barley meal and skimmilk or buttermilk), is mounted upon a high table, and is

connected with a force pump, worked by a pedal. Upon depressing the pedal a portion of the liquid paste is forced with gentle pressure through a flexible tube, the nozzle of which is inserted into the gullet of the fowl to be fattened, and the fowl thus receives his ration. A dial indicates the amount thus given, which can be regulated at pleasure. With this apparatus 125 fowls can be served in an hour.

In the apparatus shown by M. Fremond the force pump is dispensed with, and the paste is allowed to fall by its own weight, the pedal being used only to open or shut a valve in the feeding tube.

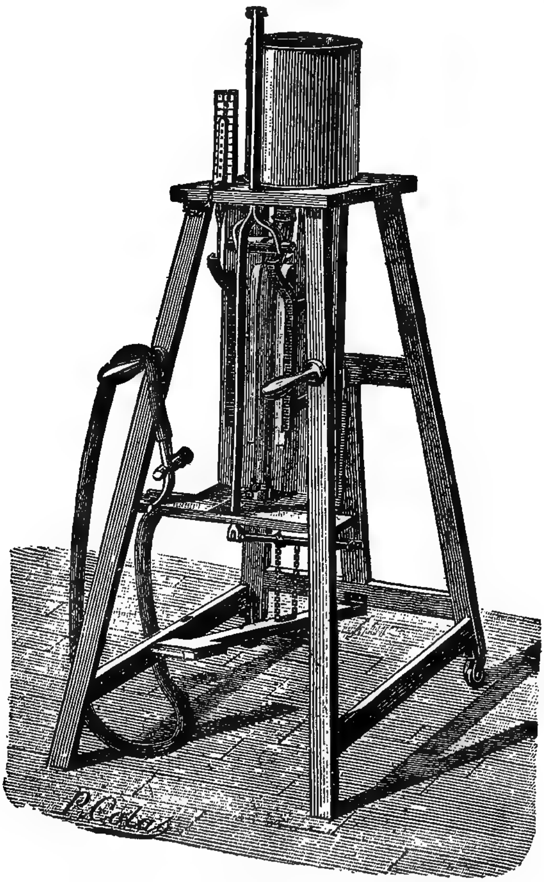


FIG. 51.—*Gaveuse.* Phillippe Fils, Houdan.

These *gaveuses* are provided with a supplementary apparatus, namely, a series of coops in stages, each coop being just large enough to contain one fowl, which is generally chained by the feet. One of these stages was provided with a very simple form of *gaveuse*, operated by hand alone, the paste simply flowing through the tube from the reservoir above. Fig. 52 also illustrates a circular revolving

stage of coops holding 210 fowls and an accessory elevator to carry the gaveuse and the attendant who operates it.

This system of fattening poultry generally requires from three to four weeks, and is not so cruel as it would seem at first sight. No great force is used, and the fowls get so used to it that they even learn to stretch out their necks and open their beaks to receive the nozzle as they see the operator approach.

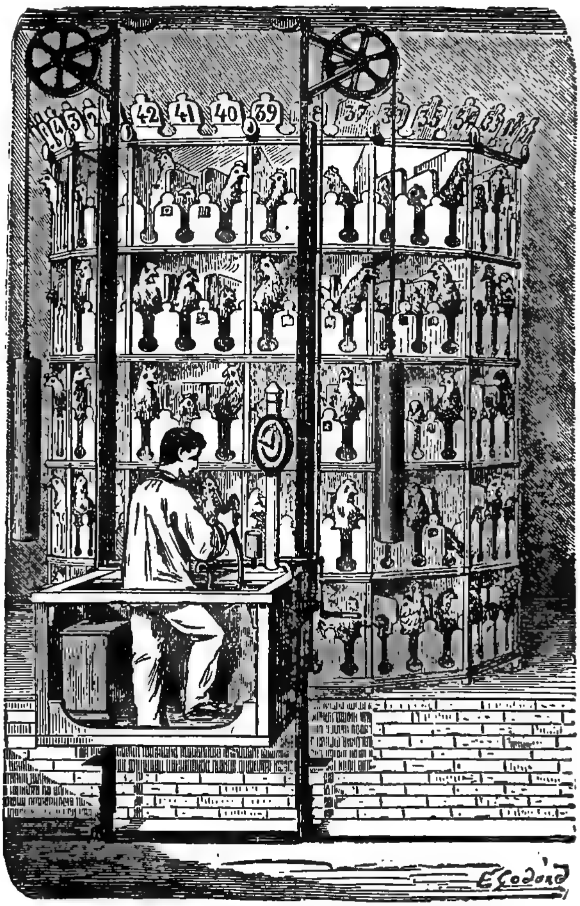


FIG. 52.—Revolving stage for 210 fowls, with *gaveuse* and elevator.

MISCELLANEOUS EXHIBITS IN CLASS 74.

In addition to the above exhibits, class 74 was rich in objects of a very miscellaneous nature, some of which were not without interest. There were several collections of minor agricultural implements, such as spades, forks, rakes, garden rollers and the like; and also several of stable furniture, such as stalls, mangers, horseshoes, collars, har-

nesses, horse clippers and various fittings, etc.; and, finally, there were many private exhibits of fleeces, tree guards, barbed wire for fencing, stuffed birds, rennet, etc.; also of veterinary medicines, and foods for horses, cattle, sheep, dogs, and poultry, besides many minor articles, only to be considered as curiosities or small conveniences, for sale.

. One novelty which attracted my attention was the saltroll (Fig. 53,) which is of English origin. Common salt subjected to hydraulic pressure is formed into a roll, which may be attached to the walls of stables or farm buildings where the cattle may lick it; a small penthouse of sheet iron protects it from the rain.

The cost of the complete apparatus is but 35 cents, and an extra roll of salt costs but 20 cents.

FIG. 53.—Salt-roll for cattle.

The little portable fences so common in France might be with advantage more extensively used by our farmers, especially for sheep and chicken inclusion or exclusion. They are made of hard-wood stakes (oak or chestnut), rather roughly cut, and united by wire, and are in sections, so as to be easily rolled up and carried about. They are made of all sizes, from 1 to 2 meters in height, and cost from 12 to 35 cents per running meter.

Among the more important of these miscellaneous exhibits, that made by the *Compagnie Générale de Voitures à Paris* was most interesting. This company is probably the largest institution of its kind in existence. It is a joint-stock company, having a capital of 42,500,000 francs, ($8,500,000,) and employs nearly 6,000 persons. It possesses 11,500 horses and 6,500 carriages of all sorts. Its workshops at the Villette cover 26,000 square meters of ground (nearly 2½

acres) and employ 1,000 workmen, who annually construct 1,200 and repair nearly 8,000 carriages. The yearly production of horseshoes amounts to 600,000.

This company made a special exhibit of their system of feeding their horses, which is as follows: The principle of this system is that the various kinds of fodder are thoroughly mixed before being given to the horse.

Practical observation has shown that when a horse eats oats or any other grain singly many grains escape mastication, and that thus there is a waste of nutritive substance. This is trifling, to be sure, for a single horse, but with the 111,500 horses of the company it becomes a serious item of expense. The way to obviate this waste is by mixing the grain with straw. Besides, by the use of such a mixture the horse consumes more than one aliment of constant nutritive value, and thus assimilation is better effected, and is more regular and complete than when oats or straw are given separately.

In order to maintain a constant nutritive value in the mixture the company has established a laboratory where all supplies are analyzed as they arrive at the stables, so that the exact proportion of each lot which should be used may be known, experience showing that the nutritive value in any grain may vary greatly even in the same variety.

The forages used by the company are oat or wheat straw, oats, maize, maize-cake, and horse-beans, a judicious mixture of these, based upon chemical analysis, affording a fodder of constant alimentary value. The horses of the company work two days, and not the third. Upon resting days each horse receives the following ration, which he consumes in four meals, at the stable:

	Grams.
Maize	6,100
Horse-beans	700
Maize-cake, broken fine	800
Oat straw, chopped fine	3,700
	11,300

Oats are omitted from this ration, which is supplemented by 200 grams of bran and 500 of broken beans made into a gruel with water.

Upon working days the horse receives one-quarter of the above ration before leaving the stable, and the driver carries with him in a nose-bag the following ration, which is given to the horse, when opportunity allows, at the cab-stands in the streets.

	Grams.
Oats	3,300
Horse-beans	500
Maize	1,000
	4,800
One-fourth of the rest-day ration being	2,825
	7,625

In the rations the nitrogenous to non-nitrogenous matter is 1 to 6.4, and this proportion is kept up as nearly as possible by varying the proportions of each ingredient according to the analyses of the supplies received. This system has been in use since 1884.

Baskets containing each of the above mixtures in their full weight, and also a full weight of each ingredient as above described, were exhibited.

The company is very careful to have all its grain thoroughly purified by a system of separators and magnetic tables.

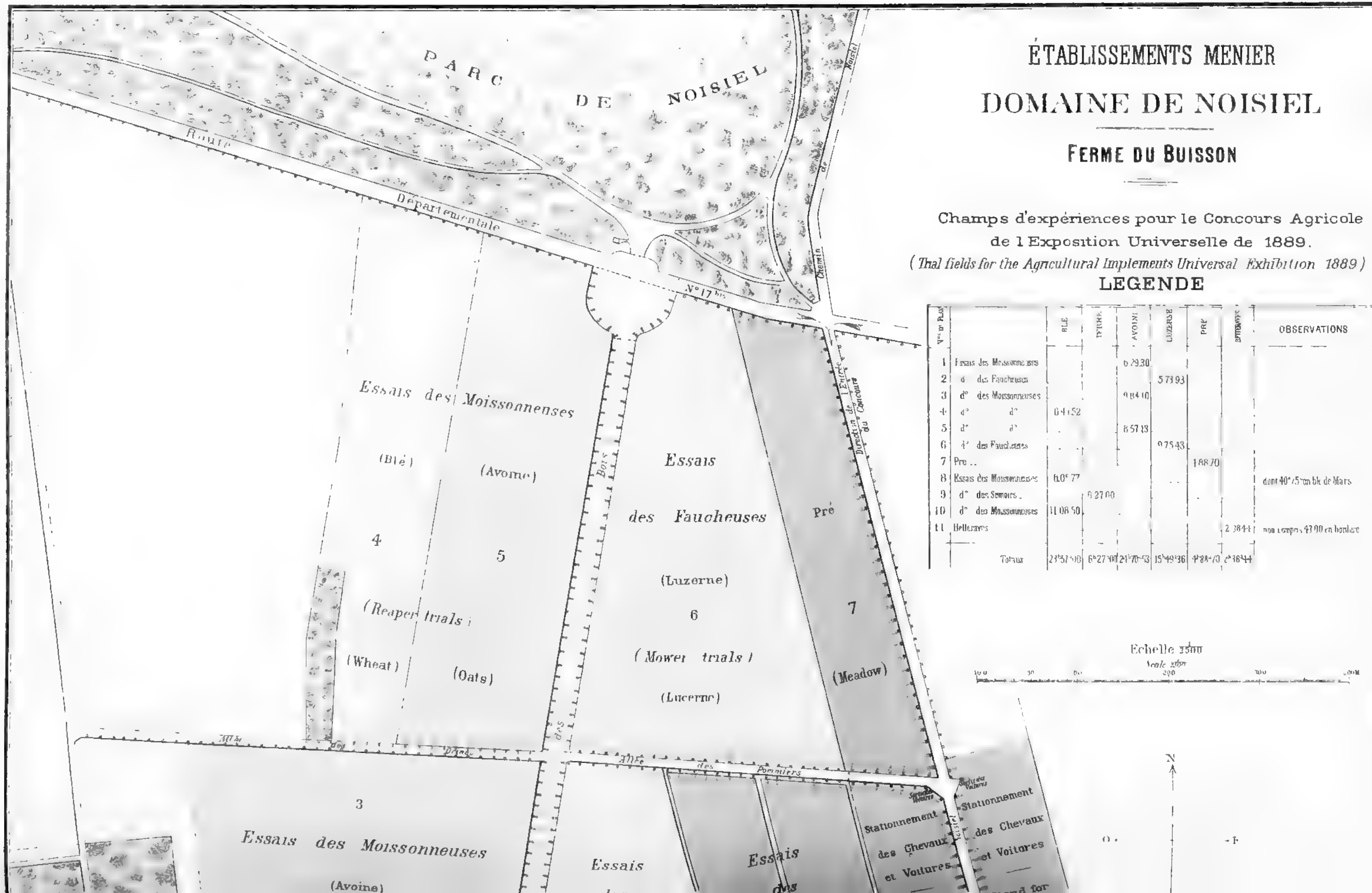
The exhibit contained samples of these grains both before and after purification, together with the refuse taken from them.

The magnetic tables had taken from these grains an incredible quantity of nails, the form of which showed that the maize at least must have come from the United States.

In connection with the above exhibit was a collection of calculi, some of enormous size, taken from the stomachs of horses which had been fed upon impure or improperly cleaned grain.

The *Compagnie générale des Omnibus* had an exhibit consisting of a series of plans and drawings illustrating its stables, granaries, silos, and store-houses.

A visit was made to the sewage farm at Gennevilliers, just outside of Paris, where the street sewage of the metropolis is utilized for the conversion of a formerly barren plain into a now fertile garden. This has been well described by Commissioner Campbell (Report of Paris Univer. Exposition, 1878, vol. V, p. 413), and the only thing to add is that ramie is added to the list of crops grown there, and was seen in July in flourishing condition and some 3½ feet high. Much of the ramie used in the trials of ramie machinery (see Report of Mr. Charles R. Dodge, Part II of this Vol.), was grown at Gennevilliers.



N°s du Plan		BLÉ	[illegible]	AVOINE	LUZERNE	PRÉ	BETTERAVES	OBSERVATIONS
1	Essais des Moissonneuses			6 29 30				
2	d° des Faucheuses				5 73 93			
3	d° des Moissonneuses			9 84 10				
4	d° d°	6 41 52						
5	d° d°			8 57 13				
6	d° des Faucheuses				9 75 43			
7	Pré					4 88 70		
8	Essais des Moissonneuses	6 0? 77						dont 40a 75ca en blé de Mars
9	d° des Semoirs		6 27 00					
10	d° des Moissonneuses	11 08 50						
11	Betteraves						2 38 44	non compris 43 00 en bordure
	Totaux	23h 57a 00	6h 27a 00	21h 70a 53	15h 49a 36	4h 88a 70	2h 38a 44	

DOMAIN OF NOISIEL, SHOWING DISPOSITION OF LAND FOR FIELD TRIALS.

CHAPTER V.

FARM MACHINERY, FIELD TRIALS, ETC.

By C. V. RILEY.

FIELD TRIALS.

The field trials of the machines in the first group, drills, etc., and the fifth group, harvesting machines, were held near Noisiel, a village of 500 or 600 inhabitants, 25 miles from Paris, on the *ferme de Buisson*, generally termed the domain of Noisiel, belonging to the widow of M. Menier, the celebrated chocolate manufacturer. In addition to the immense manufactory, the family possess a number of model farms, the estate including altogether 2,500 acres of arable land, irrigated meadows and some woods, and is admirably adapted for such extensive trials.

Madame Menier, as soon as the Exposition of 1889 was resolved upon, informed the then minister of commerce, M. Lockroy, that she would place at the disposal of the exhibitors the agricultural machinery and lands of Noisiel, and offered to plant in any manner that might be pointed out. Her proposals were accepted and the estate was sown to the various crops needed for the trials of mowers, reapers, binders, etc., and portions were prepared for the trials of other machinery.

A colored map of the domain of Noisiel is here given (Map I), on which is indicated the disposal of the land for the various trials.

The trials of insecticide and fungicide machinery, comprising the third group, were held in the vineyard of Mareil-Marley, as it was found impracticable to hold them in the vineyard of Argenteuil (Seine-et-Oise), the place first determined upon.

The second and third groups were tested in Paris, rue Jenner, at the station for the trial of machinery. Dairy apparatus—the fourth group—were tried on the Esplanade des Invalides and on the quai d'Orsay, Paris.

The sixth group, comprising materials and methods for preparing dry fruits, was dropped, owing to the fact that no competitors presented themselves.

The regulations governing these trials were issued May 26, 1889, by P. Tirard, minister of commerce, etc., and were as follows:

[Translation.]

SPECIAL RULES FOR THE PRACTICAL TRIAL AND SPECIAL COMPETITION OF AGRICULTURAL MACHINES AND IMPLEMENTS.

ARTICLE 1. The practical trials and special competition of machines and implements of agriculture will take place during the course of the Universal Exposition.

The machines and instruments admitted to these trials will be worked under the normal conditions of practice and during a time sufficiently long so that it may be possible to appreciate their merits.

ART. 2. These trials will apply to French and foreign machines belonging to any of the following groups:

I. Drills in lines or hills for cereals, grains of any kind; spreaders and distributers of fertilizers and insecticides.

II. Apparatus to filter wines.

III Insecticide and fungicide apparatus.

IV. Dairy material. Apparatus for the preservation and transportation of milk, for the separation of cream, for the manufacture of butter and cheese; creamers, churns, presses, utensils, etc., rennets, and boxes, etc., for the keeping and shipping of dairy products.

V. Machines for mowing and harvesting. Binding harvesters and machines for binding independently; loading apparatus; elevators; portable hay and straw presses.

VI. Materials and methods of preparing fruits. Drying, preserving, and packing of dried fruits (plums, apples, raisins, etc).

VII. Apparatus for the decortication of ramie.

ART. 3. The practical trials will take place on the dates designated below:

First group: Grain drills and the distributors of pulverized and liquid fertilizers, and insecticides for cereals, beets, and other agricultural products, Monday, June 10, on the ferme de Noisiel (Seine-et-Marne).

Second group: Wine filtering apparatus, Thursday, June 20, at the station for the trial of machines, rue Jenner, Paris, France.

Third group: Spraying apparatus, first week of July, in the vineyard d'Argenteuil (Seine-et-Oise).

Fourth group: Dairy apparatus, from the 15th to the 22d of July, on the Champs-Élysées, Paris, during the grand exhibit of live stock.

Fifth group: Mowers and harvesters and independent binders, loading apparatus, elevators of hay and straw, presses of hay and straw, from the 25th of July to the 10th of August, on the ferme de Noisiel (Seine-et-Marne).

Sixth group: Apparatus and methods of preparing fruits—drying. During the second half of August, at the station for the trial of agricultural machines, rue Jenner, Paris.

Seventh group: Apparatus for the decortication of ramie. Second half of August or first week of September, at the station for the trial of machines, rue Jenner, Paris.

ART. 4. The precise location and date for the practical trials will be indicated later, and five days or less in advance.

ART. 5. Inventors, constructors, or dealers of whatever nationality, exhibiting at the Universal Exposition of 1889, are admitted to these trials.

ART. 6. Exhibitors who wish to take part in one or other of these trials must make their application, in writing, to the general director of trials, 16 avenue de la Bourdonnais, Paris: For the first group, the 1st of June or later; for the second

group, the 10th of June or later; for the third group, the 20th of June or later, and for the other groups, June 30, or later. Each application should contain the full name, business, and address of the exhibitor, the date of the invention of the machine, or its latest improvement; the name of the inventor; the weight of the machine; its capacity for work; its price; the number of machines already sold, and all other data necessary for the information of the jury.

ART. 7. A special jury will be named for each trial. This jury will be composed essentially of the members of the international jury of awards in the classes in question and of special deputy members. The jury will designate its president and name a secretary to report the result of the trial. It will decide on the nature of the tests employed; on the divisions to be established between the various machines of each group, and on the conditions under which the trials will be held.

ART. 8. The exhibitors admitted to the trials must present either one of the machines on exhibition or a machine of identical construction, which should be in place ready to be operated at the hour fixed by the jury.

ART. 9. Each exhibitor will be required to provide himself, at his own expense, and as he shall require, the men, teams, fuel, or other means necessary to the working of his machines and instruments. The expense of transportation, going and returning, shall also be at his charge. He must submit to all the tests prescribed by the jury.

ART. 10. The jury may allow any exhibitor whose machine may be broken or rendered unserviceable or stopped while being tested, to replace it with an identical machine.

ART. 11. The special commissioners will be charged with all that concerns the organization and conduct of the trials, and subsequent dispositions.

ART. 12. There will be no classification in the order of merit, but all exposing machines, instruments, or apparatus which are judged worthy may receive one or other of the awards provided in the rules of the international jury of awards. The jury will have in addition at its disposition ten *objects d'art* to reward exceptional merit. Each jury shall make the awards in accordance with the results of the practical tests. The jury shall take into account, however, in its own judgment, the value of the machine or instrument from the point of view of construction and of operation.

ART. 13. The president of each jury shall transmit, within 15 days, to the general director of the trials, the report drawn up by the secretary and approved by the jury on the results of the trials and tests of the jury.

ART. 14. At the close the presidents, vice-presidents, and secretaries of each jury shall come together to listen to the reports of each special jury and to determine definitely on the disposal of the awards. The full report shall be transmitted immediately to the general director of the trials.

Paris, May 26, 1889.

Le ministre du commerce, de l'industrie et des colonies, commissaire général.

P. TIRARD.

SEEDERS AND DISTRIBUTERS OF FERTILIZERS AND INSECTICIDES.

The trials of the first group of agricultural machines, including the drills and seeders and distributers of fertilizers and insecticides either powdered or liquid were held on the 10th and 11th of June on the *ferme de Buisson,* Noisiel, which Madame Menier had graciously placed at the disposal of the jury. Thirty machines took part in the trials. This number may, perhaps, be considered small in view of the importance of this class of machines in the Exposition.

Almost all the French manufacturers were represented, except MM. Albaret and Gautreau, who, being members of the jury, were *hors de concours*, and did not enter their machines in competition. There were no American competitors, and foreign countries were meagerly represented—there being in fact only the grain drill of Smyth & Sons (England) and the fertilizer distributer, the *Hérisson*, constructed in France, but of German origin.

The implements submitted to the trials were divided into five classes, as follows:

(1) Drills in lines of eight rows and above.
(2) Drills in lines of seven rows and under.
(3) Beet drills.
(4) Drills in hills (*à paquete*).
(5) Distributers of fertilizers.

CLASS 1. DRILLS IN LINES OF EIGHT ROWS AND ABOVE.

The competitors in Class 1 were the following: Hurtu (France); Japy (France); Liot (France); Smyth & Sons (England), represented by M. Maraval, Paris (France).

Trials were made with the grains named below:

First. Wheat treated with blue vitriol, in lines 0.15 meter apart and at the rate of 150 liters to the hectare.

Second. Barley, width of rows 0.30 meter; 150 liters to the hectare.

Third. Corn, width of rows 0.30 meter; 50 kilos to the hectare.

Fourth. Small grains (Lupine), width of rows 0.18 m; 10 kilos to the hectare.

In all these trials the seeders were provided with sacks which were attached to each shovel to receive the seed and thus make it possible to determine the amount sown. The drills were drawn in a straight line for a given distance. Knowing then the distance traversed and the width of the rows and their number (or the width covered by the machine) and the weight of the grain taken in the sacks, it was possible to deduce the quantity of grain drilled to the hectare.

By an examination and comparison of the sacks, the weight of grain furnished by each shovel could be learned and any irregularity in the distribution noted.

These trials have shown that the cultivator has at his command machines that respond very well to all practical needs. It is possible to drill at any desired width or depth, the soil being uniform, and at a given rate per hectare. The distribution also is regular. It appears, however, that the large drills can not sow at a rate below 120 liters per hectare and it would be well if the amount could be reduced to 60 or 80 liters per hectare, and this may be accomplished by causing the distributing axis to move at a slower rate.

CLASS 2. DRILLS IN LINES OF SEVEN AND UNDER.

The competitors in this class were: Hurtu (France); Japy (France); L'Hermite fils (France); Magnier (France); Maréchal (France); Perret, Michel (France); Robillard (France); Prat Frères (France); and Smyth & Sons (England).

The seeders of Smyth & Sons and Hurtu have the distributers spoon-shaped (*à cuillère*) and are mounted on three wheels. In the Smyth machine the wheels are fixed. The Hurtu drill has the small front wheel movable, and under the control of the conductor, as in the larger drills.

The seeders of Magnier, Maréchal, Pelat-Schung, and Robillard are provided with fingers or rods which push the grain across orifices of varying size (*à paleronc* or shaped like a shoulder-blade). The size of each of these openings is regulated independently of the others in all these machines, except in the Magnier seeder, where the openings are all altered at once by a single movement of a lever.

The Robillard seeder is an *avant-train;* i. e., has a fore-carriage.

The seeders of Perret and Prat have cupped distributers (*à alvéoles*); and the size of the cups or depressions in the revolving wheels may be modified to suit the size of the grain to be sown. The Prat seeder is provided with an *avant-train* which is controlled by the operator by means of a horizontal screw worked by a crank. In the Japy seeder the distribution of the grain is effected by means of a horizontal screw.

The implement entered by M. L'Hermite was introduced in 1887, and consists of a small two-row drill mounted on an ordinary two-horse plow. The distribution is effected by means of undulating disks mounted on a solid horizontal axis provided with a large wheel. When the seeder is lowered (it is mounted on a hinge or turning joint on the posterior extremity of the beam) the wheel turns on the ground and revolves the undulating seed distributers. The sowing may be stopped at any time by raising the entire seeding apparatus. The rate of sowing is modified by changing the size of the orifices, and the entrance of the shovels into the soil is variable within certain limits, but their width, 0.15 meter, is constant. This machine is intended for limited culture. The width of the lines may be varied within certain limits with all the machines of the second class, except in the case of those of L'Hermite (2 rows, width 0.30 meter); and Prat (4 rows, width 0.25 meter).

The seeders of the second class were submitted to the same tests as those of the first class (wheat, barley, corn, and small seeds trials being made in sacks). The general judgment made in reference to the machines of the first category are applicable also to the second. However, the *avant-train* may be considered as superfluous, requiring as it does an additional man to operate the machine.

Class 3. Beet-drills.

Several of the machines of the two previous categories, intended for the planting of other seeds than the cereals, were entered with the beet seeders. The following are the entries in the third class: L'Hermite, Maréchal, Pelot-Schung, and Robillard. The L'Hermite machine was the one that had already figured in the second class. There is nothing of note to record. The seed was distributed as uniformly as in the other trials. The competitors were required to sow at the rate of 25 kilos of beets to the hectare, the rows being a distance apart of 0.30 meter.

The seeders, with the exception of L'Hermite's, were of the type *à paleron,* already described.

It would seem, as a result of the trials, that it is unnecessary to have recourse to special seeders for beets, any more than for the smaller seeds.

From the point of view of economy, it is evident that drills sowing all grains are preferable.

Class 4. Drills in hills (*à paquets*).

The seeders styled *à paquet* (in hills or broken lines) would hardly be called drills in this country. They correspond with our machines for planting corn, cotton, etc., and it is to be regretted that none of the American manufacturers of this style of apparatus were represented.

In this class were entered the seeders of Class 1 of Robillard and Smyth & Sons, and two models by M. Brichard, of Seine-et-Oise (France).

With the Robillard and Smyth seeders the mechanism for hill planting is mounted on the ordinary seeder. A slide closes the lower extremity of the telescopic tubes, and from time to time a mechanism put in movement by the transporting wheels opens the slide and allows the grains to fall.

The Brichard seeders are constructed to plant *à paquet,* and cost in the neighborhood of 100 francs to the shovel (drill). They are very well suited for small cultures or for kitchen gardening, and are quite generally employed for this purpose about Paris.

It does not appear that the drills *à paquet* as used in France are as useful for large cultures as the drills in continuous lines.

The competitors in Class 4 were required to plant the hills at a distance, one from the other, of 0.20 meter, the rows being 0.25 meter apart. The following seeds were experimented with: Wheat, at the rate of 70 liters to the hectare; peas, at the rate of 70 kilos, or 125 liters, to the hectare; beans, at the rate of 100 kilos to the hectare.

CLASS 5. DISTRIBUTERS OF FERTILIZERS.

The entries for the trials in Class 5 were: Caramija-Mauge, Paris (France); Faul, Paris (France); Fortin frères, Montereau (Seine-et-Marne, France); Hurtu (France); Magnier (France); Mahot, Ham (Somme, France); and Smyth & Sons (England).

The following substances were distributed: Plaster, 600 kilos to the hectare; nitrate of soda, 400; superphosphate (moist), 1,000.

The uniformity of the distribution of the plaster could be easily noted on the ground.

The superphosphate was moistened, containing 10 liters of water to 100 kilos of the powder. To observe the regularity of the distribution of the nitrate of soda and the superphosphate, the drills passed over a sheet placed across the path traversed. When the material is pasty or doughy the amount sown rapidly falls off, because the fertilizer will not pass readily down the hopper. If the distribution is effected by chains, the machine becomes rapidly clogged and incapable of satisfactory work.

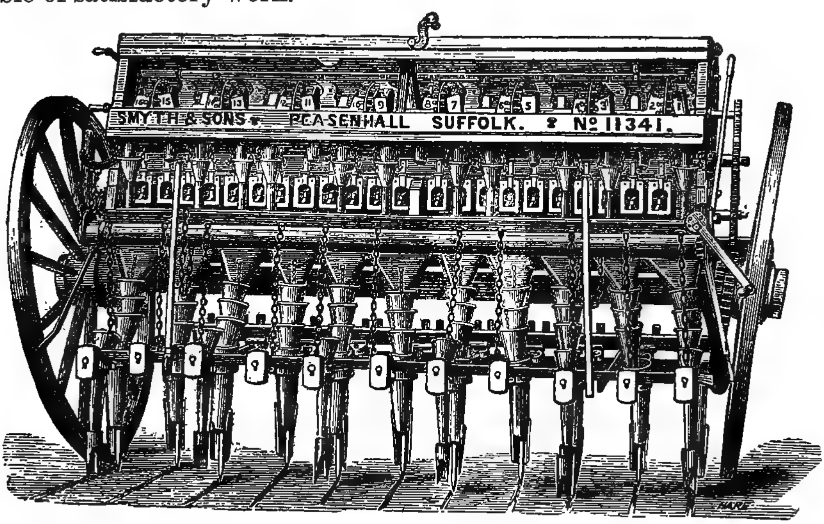


FIG. 54.—Wheat, seed, and manure drills. Smyth & Sons, Peasenhall, Suffolk, England.

The trial brought out the excellence of the machine of the type *Hérisson,* which is of German origin. The first machine of this kind imported into France and patented there is that of Faul. Hurtu's machine is of similar construction and only differs from the former in its method of being placed in or out of gear. These machines seem to have great durability. Fortin Brothers' machine approaches them in principle of working. I introduce figures, with brief descriptions, of a number of the representative drills taking part in the trials.

Fig. 54 represents one of the excellent drills manufactured by

Smyth & Sons, Suffolk, England. These drills are unsurpassed for drilling manure with either wheat or other seeds, and each drill is constructed with one wheat and one manure compartment. The manure and grain boxes are made separate, so that the manure box can be wholly detached when drilling wheat or seeds without manure. The grain is conducted down the same coulter as the manure, but turnip or mangold seeds pass through separate coulters, allowing the manure to be covered with a portion of the soil previous to the seeds being deposited. The price ranges, according to the number of rows, from £42 to £57.

Fig. 55 represents one of the Japy drills with shafts. It has a somewhat clumsy appearance when compared with American or English drills, but is capable of doing very good work.

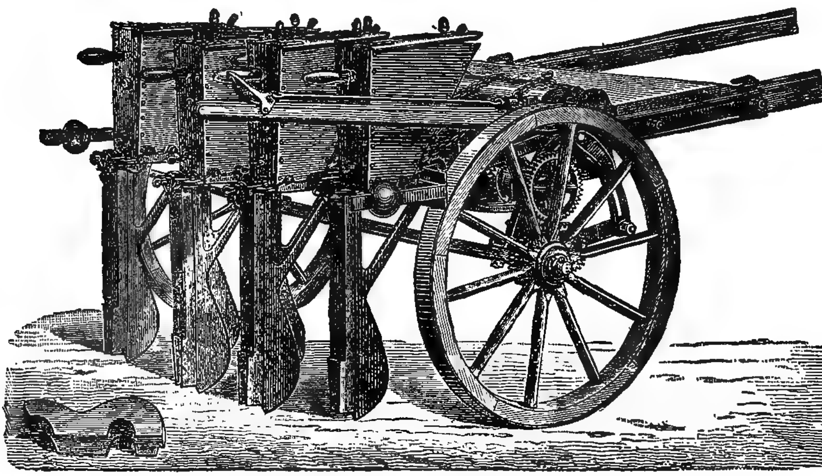


FIG. 55.—Japy grain drill. Japy frères.

The distribution of seeds is effected by means of an Archimedean screw, which introduces the seeds to the shovels with mathematical regularity.

A French drill, manufactured by M. Albaret for planting (*à paquet*) corn, beans, and peas, is shown at Fig. 56. It is constructed entirely of iron, mounted with avant-train, and may be drawn by a single horse. The separation of the shovels may be varied and their number may be increased to four.

The French drills, *à paquet*, do not plant in hills, properly speaking, but rather in interrupted rows. It is needless to observe that the American implements of this class, such as listers and corn-planters as well as drills proper, far excel the French machines, and, as already stated, it is to be regretted that none of the American machines appeared at the trials or in the Exposition.

Particular attention is also drawn to the fertilizer distributer "Le Hérisson," constructed by Ch. Faul, Paris, France, to which

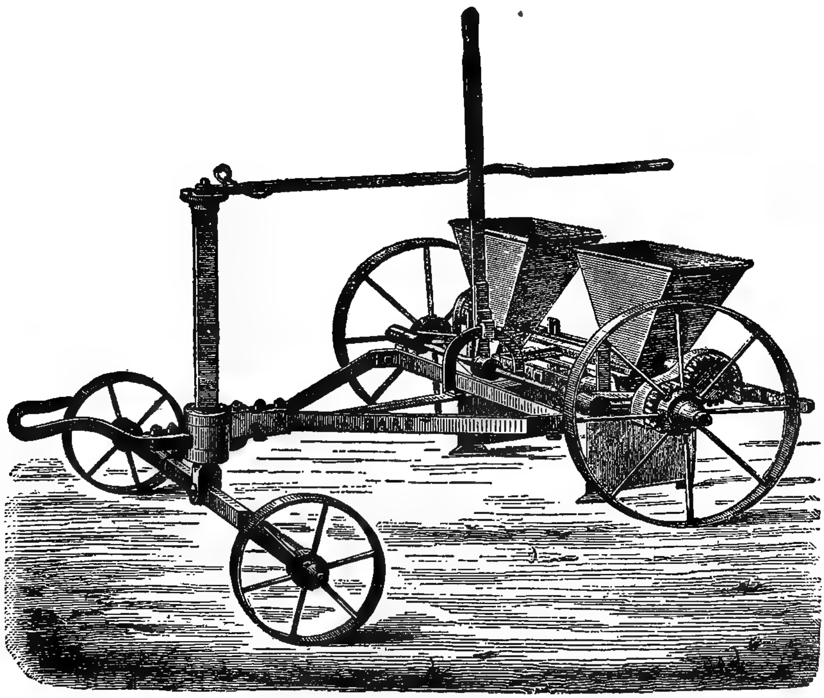


Fig. 56.—Drill à paquet. M. Albaret, Liancourt-Rantigny (Oise), France.

reference has just been made. Fig. 57 gives a general view of this implement and indicates somewhat the nature of its construction,

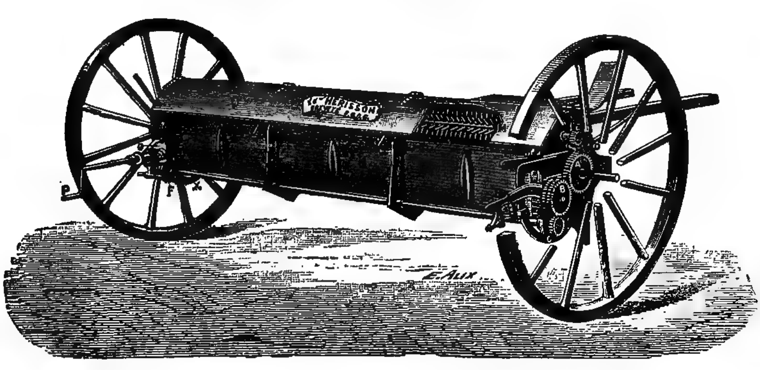


Fig. 57.—The Hérisson distributer. Ch. Faul, Paris, France.

which is more clearly brought out in Figs. 58 and 59. The long box N, Fig. 57, which will contain 125 to 140 kilos of fertilizer, is formed

of two parts. The anterior part O, Figs. 58 and 59, is movable and is made to raise automatically during the working of the machine. The distribution of the fertilizer is effected by means of the revolving beam, M, the nature of the work of which is sufficiently well indicated in the figures.

The following is a list of awards in Class I:

Gold Medals.—M. Hurtu, Nangis (Seine-et-Marne), France; Smyth & Sons, Suffolk, England; Liot & Fils, Boisguillaume (Seine-Inferieure), France.

Silver Medals.—M. Robillard, Arras (Pas-de-Calais), France; Japy frères, Beaucourt, France.

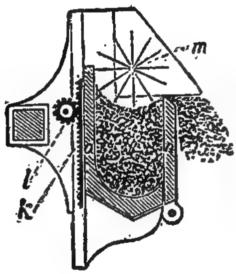


FIG. 58.—Same, in section.

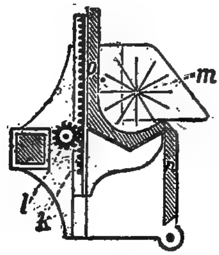


FIG. 59.—Same, in section.

Bronze Medal.—Maréchal, Arras (Pas-de-Calais), France.

BEET-SEEDERS.

Silver Medal.—M. Robillard, Arras (Pas-de-Calais), France.

FERTILIZER DISTRIBUTER.

Gold Medals.—M. Faul, Paris, France; M. Hurtu, Nangis, France.

FUNGICIDE AND INSECTICIDE MACHINES.

The third group of the special trials of agricultural machines, comprising sprayers and powder-blowers for the destruction of the insect and fungus pests of plants, and particularly of the vine, should have been held during the first week of July in the vineyard d'Argenteuil (Seine-et-Oise). It was found necessary to abandon this arrangement and to hold the trials in the vineyard of Mareil-Marley, which was kindly placed at the disposition of the jury.

Twenty-five machines took part in the trials: Twenty-two sprayers, two powder-blowers, and one horse-sprayer (*pulvérisateur à traction*).

The competitors were all French and were the following:

Beaume, Boulogne-Sur-Seine, two sprayers.
F. Besnard, Paris, presenting a sprayer of the Duros principle.
Fernand Bourdil, Paris.
F. Blouctet, Beaume (côte-d'Or).
Bruel-et-Brunat, Moulins (Allier).
H. de Chasseloup-Laubat, Périqueux (Dardogne).
Duvaldestin, à Orleans (Loiret).
Japy frères et Cie, à Beaucourt (Haut-Rhin français), three sprayers.
Lasmolles-Fréchou, Nérac (Lot-et-Garonne).
Marlin, presenting a sprayer on the Decombe principle, constructed by A. Bouin, à Blèré (Indre-et-Loire).
H. Monserviez, à Bordeaux, two sprayers, one on the Loumaque principle and the other on the Duru principle.
Noël, Paris.
G. Pepin fils, à Bordeaux.
Perrin, à Liergues (Rhône).
Jules Roth, à Paris.
V. Vermorel, à Villefranche (Rhône).
Henri Vigneau, à Aiguillau (Lot-et-Garonne).
A. Yvert, of Mareil-Marley (Seine-et-Oise).

The powder-blowers were exhibited by MM. Alfred Langlais, of Alger, and V. Vermorel, mentioned above.

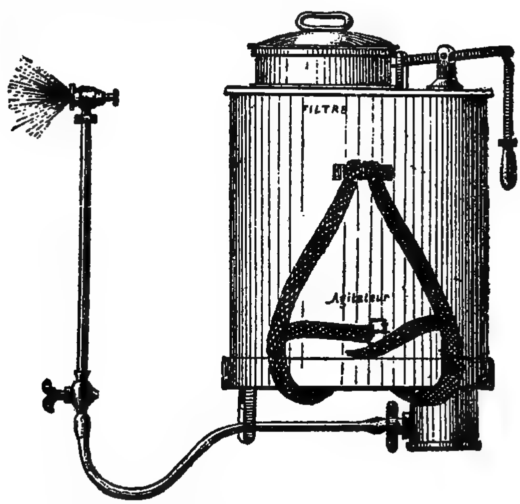


Fig. 60.—Japy sprayer, Model "C," with Riley nozzle.

The horse sprayer (*à traction*) was exhibited by M. Vermorel.

The sprayers were first tried with water strongly colored with Paris violet. The second trial was made with a mixture of 2 kilos of sulphate of copper and 0.5 kilo of lime to 100 liters of water. It will not be necessary to describe in detail the various machines which took part in the contest. Most of them are well known to orchardists and vineyardists of this country as well as France.

Points of difference in the various devices may be noted.

The sprayers experimented with may be grouped in several classes according to the principle of their construction:

(1) Machines in which the liquid is forced through a pump to the nozzle. This pump is often a suction and force pump or sometimes a simple force pump, placed in the interior of the reservoir itself. In certain of the pumps an agitator is put in movement by the action of the piston. In this category may be placed the pumps of Brunel & Brunat; Chasseloup-Laubat; Japy (two pumps: model C for limited work, Fig. 60, and model D, for more extended operations, the latter being provided with a chamber for compression); Duru (Monserviez); Perrin (also with compression chamber); Vermorel (sprayer called *Éclair* having the pump placed on the lower part of the reservoir); Duvaldestin; Vigneau (sprayer called *le Clésibius*).

FIG. 61.—Vermorel sprayer, "l'Éclair," Model of 1889.

The pistons are generally constructed with leather packing. In the Japy pumps, the piston is of excellent construction, being made on the Letestu principle, which is very well adapted to working with thick or pasty mixtures and has long been employed in exhaust pumps to raise water containing mud, sand, or pebbles.

In the Vermorel sprayer (Fig. 61) a jet of liquid is directed into the reservoir playing the rôle of agitator. This pump has no piston, this being replaced by a semicircular rubber diaphragm which is made concave or convex by the movements of the lever and thus regulates the suction and expulsion of the liquids in the reservoir. An air chamber insures continuous delivery. The nozzle employed on the Vermorel sprayers, and generally adopted with slight changes by many French manufacturers, and also commonly used in the United States, is a modification, and perhaps the most important one, of the well-known Riley nozzle. The Vermorel nozzle is shown entire and in section at Fig. 62. The important feature of this nozzle is the pin inserted through the base, bearing on its upper end a point sufficiently small to enter the discharge orifice when thrust upward from below. This enables the operator to clear the discharge, and is a great convenience, especially for spraying heavy liquids.

The Japy modification of the Vermorel nozzle is shown reduced at Fig. 63. The principle is the same as the Vermorel, but works in the opposite way. In the normal position the thumb lever *a* is suffi-

ciently raised by the spring placed between it and the tube to throw the needle *c* down in such manner as to close the discharge orifice. It thus acts at once as a disgorger and a stop-cock.

(2) Sprayers constructed with an air-tight reservoir in which the liquid is placed. An air pump forces air into the base of the reservoir. The liquid is kept perfectly agitated by the passage of the bubbles of air and the compression of the air forces the liquid through a rubber tube to the nozzle.

In this class occur the machines of Besnard, Lasmolles-Fréchou, Decombes, Loumagne (Monserviez), Roth, Noël, and Beaume.

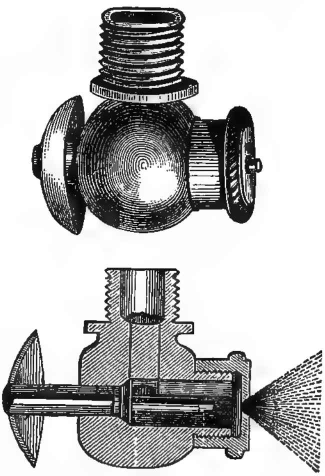


FIG. 62.—The Vermorel nozzle—natura size.

The sprayer contrived by M. Fréchou, druggist at Nérac, and manufactured by M. Lasmolles, is very ingenious. The apparatus consists of a wooden box to which is fixed an air pump. The reservoir consists of a glass flask, having a capacity of about 10 liters, inclosed in an osier basket work such as is employed in shipping chemicals. A rubber stopper carries two tubes which extend nearly to the bottom of the flask; one of the two is connected with the air pump and the other with the nozzle.

The stopper is held in place by means of a small iron lever, which prevents its being forced out by the interior pressure. In the practical use of this sprayer a number of flasks (costing about 2 francs each), similar to the one described above, are prepared in advance and distributed in the vineyard; when one is emptied it is replaced by another, and after adjusting the tubes the operation continues with very slight interruption.

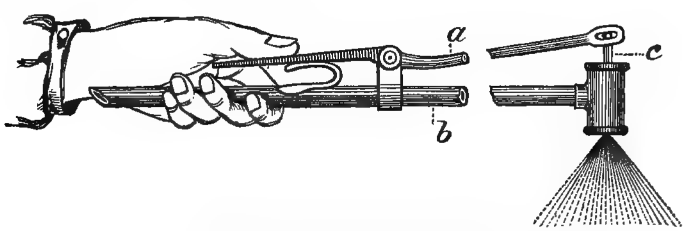


FIG. 63.—The Japy nozzle—reduced.

It is apparent that the Fréchou sprayer much resembles a laboratory apparatus; it economizes hand labor, and the nature of the reservoir makes it especially useful for the treatment of Anthracnose, the glass not being acted on by the corrosive liquids employed.

The Noël sprayer (Fig. 64) is a carefully wrought-out apparatus and is strongly made. The receptacle has a capacity of about 15

liters, and has a diaphragm air pump worked by a lever at the lower extremity, which forces a considerable quantity of air through the liquid, agitating it energetically and keeping it thoroughly mixed.

FIG. 64.—The Noël sprayer.

The construction of the pump prevents any of the leakage that occurs in other pumps about the piston and related parts. On the

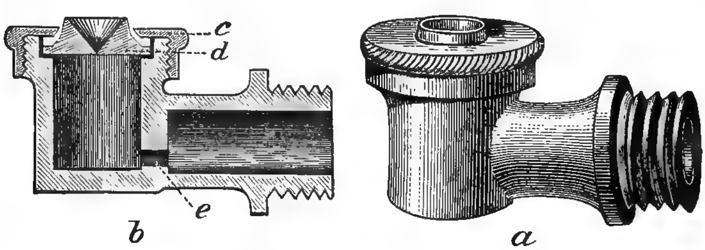


FIG. 65.—The Noël nozzle—natural size.

side of the sprayer opposite the handle is a rubber tube leading to the nozzle. The latter is the Noël type of the Riley or Cyclone nozzle, and is shown at Fig. 65, *a* entire, *b* in section. In the case of

this nozzle, the liquid, on entering the chamber, first issues from the central orifice exactly as in the Riley type and is diffused at the outset in a diverging cone-shaped spray; but the pressure of the whirling liquid rising into the upper chamber forces itself around the valve-like disk *d*, and depressing it, partially issues around the outer rim of the disk in a converging cone of spray, thus interfering with the discharge from the central orifice. It is claimed that this tends to greater diffusion and admits of the passage of a larger quantity of the liquid.

In the Roth sprayer the air-pump, which is placed above the reservoir, is of the Nines type, the piston operating with an alternating circular movement.

(3) Sprayers consisting of a reservoir which communicates by a rubber tube with a hydronette or syringe which the operator manipulates while moving along.

In this category may be classed the apparatus presented by Bourdil, Japy, and Pepin.

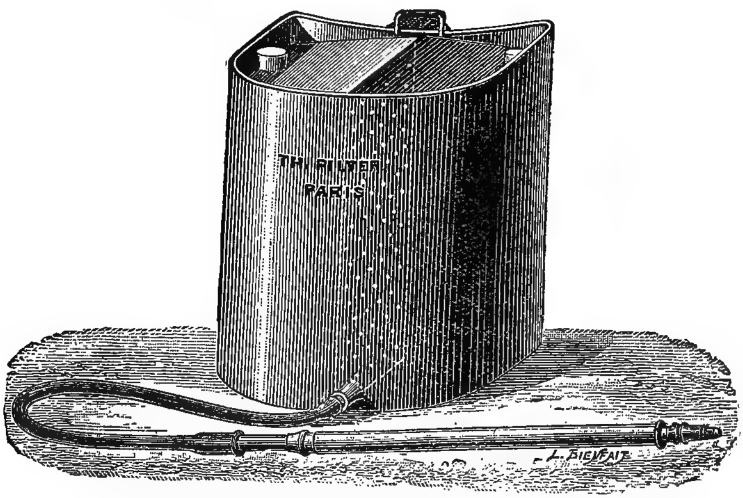


Fig. 66.—Pilter-Bourdil sprayer.

The excellent Bourdil sprayer invented within the last few years and known under the name *Pilter-Bourdil*, manufactured by Th. Pilter, of Paris, is herewith illustrated. (Fig. 66.)

M. Bourdil, the inventor of the sprayer, after considerable experiment became convinced that the sulphate of copper employed against the mildew should be projected with considerable force and in comparatively large drops against the vines, to agitate the leaves and allow their being entirely moistened on both surfaces. The apparatus devised after much experiment consists of a simple reservoir to be strapped to the back of the operator and a pump in the form of a syringe. The nozzle consists of a nickled brass rod terminated by

a circular cap and inclosed by a rubber sheath. The liquid, passing in a sheet about the rod, strikes the sharp edge of the cap and is broken up into a conical spray.

By employing sheaths of varying size one can modify at will the fineness of the spray, and by placing metallic clasps on the sheath the amount of the spray can be readily regulated. The elasticity of the rubber prevents clogging, and this substance is also not affected or injured by the Bordeaux mixture.

(4) In this group may be classed the machines of Yvert and Blouctet.

The sprayer of M. Yvert consists of two vertical vessels bound together; the smaller comes directly against the back of the operator and contains the liquid to be sprayed; the other is a large air reservoir. A metallic tube provided with a stopcock connects the two reservoirs. The liquid is placed in the smaller reservoir, and the air in the larger is compressed by means of a separate air pump, which is provided with a pressure gauge, and connects with the air chamber above described by means of a rubber tube. One pump will suffice for several sprayers. At each charging of the sprayers forty or fifty strokes of the piston are necessary, but once charged the apparatus works continuously until the liquid is exhausted.

The Blouctet sprayer (a very primitive one) consists of a simple wooden tank or vessel to contain the liquid. A rubber tube leads from the bottom of the tank to the spraying device, which is a wooden tube or nozzle with a brush covering the discharge orifice. The liquid by its own weight flows against the brush and is broken up into drops of greater or less size.

In general the sprayers worked very well. Almost all were provided with some modification or other of the Riley nozzle, either with or without a degorging pin. Of these the Vermorel, Japy, and Noël modifications have already been alluded to. In several of the sprayers the nozzles were capable of being revolved so as to project the spray in different directions.

The following data relating to the weight and capacity of these implements may be of interest:

Name of sprayer.	Weight.	Capacity.	Name of sprayer.	Weight.	Capacity.
	Kilos.	*Liters.*		*Kilos.*	*Liters.*
Besnard	6	14	Noël	6	12
Bourdil	8.8	18	Pepin	4.7	10
Chasseloup-Laubat	5.8	10	Perrin	6	10
Japy, style D	7	15	Roth	9.8	10
Japy, style C	6	10	Vermorel (*l'Éclair*)	6	15
Japy, with syringe	4	15	Vigneau	5	12
Lasmolles-Fréchou	8.5	10	Yvert	6.5	12
Marlin-Décombes	4.5	18	Duvaldestin	6.5	15
Monserviez, Loumagne	6.0	12	Blouctet	5	14
Monserviez, Duru	5.2	12			

The price of these sprayers varies from 27 to 50 francs.

The working of the first group of implements with a pump direct when there is no compression reservoir is not very regular. In fact, the pressure is almost nothing at the end of the stroke of the piston, attaining its maximum about the middle of the stroke. A short quick stroke, learned by experience, is required to produce the best results.

With the syringe style of pumps the action is intermittent, but very energetic, and there is danger with a long piston of its bending, thus rendering the implement worthless.

With the air-pump sprayers the thorough mixing is assured without recourse to any special mechanism, the spray is regular, and it is not necessary for the operator to pump continuously.

Economy in the use of the liquid is not very essential, as the sulphate of copper and the lime are of insignificant cost, and the necessity of producing machines at a low price to insure their sale among the French vineyardists prevents the manufacture of more carefully constructed, and at the same time more expensive, machines.

The reservoirs are of brass, red copper, or sheet lead. The two former are preferred. Brass is more rigid and less easily injured than copper, the use of which slightly increases the cost of the apparatus. In the Vigneau sprayer a slab of cork protects the back of the operator from the cold liquid contained in the reservoir.

The majority of the sprayers treat but one row of vines at a time, some few spraying two or more rows.

It is not necessary to dwell at great length on the two powder blowers entered at the trials. That of M. Langlois is an ingeniously arranged bellows. The current of air passes into the box containing the powdered sulphur, in which is a sliding pulverizer to break up lumps that may occur. A special arrangement is made to prevent the powder being drawn into the bellows during inspiration, and a sort of nozzle at the extremity of the discharge pipe causes the powder to spread out into a cloud.

The sulphur blower for extensive work of M. Vermorel, called "*la torpille*" (the torpedo), resembles a knapsack sprayer somewhat. The reservoir or box will contain 10 kilos of powder. A sort of slide valve regulates the distributions. The bellows is worked by a lever attached above, to which is hung a handle rod.

The traction sprayer of Vermorel referred to in first part of this chapter consists of a copper reservoir of a capacity of about one hectoliter mounted on an axle turned by the two carrying wheels. The axle works two diaphragm pumps like the one described in connection with the Vermorel knapsack sprayer. The liquid is driven through two vertical tubes, each provided with three nozzles. The use of shafts and horse to draw the apparatus allows of its being employed only when the rows of vines are quite widely sepa-
ra

The awards resulting from the trials of this class were as follows, but my own judgment would have differed from that of the jury, which did not sufficiently appreciate the work of the Vermorel machines:

Object of Art—Noël, Paris, France.

Gold Medal—Bourdil, Paris, France.

Silver Medal—Lasmolle-Fréchou, Nérac, France. Japy frères, Beaucourt.

The entire absence of American machines is to be regretted, and particularly of those intended for extended work. In the smaller or hand machines the French probably excel other countries. The exhibit of insecticide apparatus in connection with the United States Department of Agriculture is described in part in another portion (Chapter XVII and Appendix V) of this report.

THE INTERNATIONAL TRIAL OF MOWERS AND HARVESTERS AND HAY-PRESSES.

The special trial of Group 5 of agricultural machines, comprising the mowers, reapers, and binding reapers, and also portable hay and straw presses was held on the 19th, 20th, 21st and 22d of July, on the ferme de Noisiel, which Mme. Menier had placed at the disposition of the commission for the trial of various agricultural machines, and on which the trials of drills and distributers of fertilizers had already taken place.

Fifty machines took part in the trials: 22 mowers, 7 simple reapers, 2 combined reapers and mowers, 12 binding reapers, 7 forage presses.

THE BINDING REAPERS.

In point of general interest, the trial of the binding reapers was by far the most successful of all the trials of agricultural machines held in connection with the Exposition. A large concourse of people were attracted to the trials, including the President of the French Republic, M. Carnot, and a host of ministerial and official celebrities. The representatives of the foreign sections exhibiting at the Exposition were all present, and among them Gen. Franklin, the United States Commissioner. The Americans were present in force and manifested no little enthusiasm over the success of the American competitors. A special review of binders, reapers, and mowers was held for President Carnot and his suite, and the day was closed with a grand banquet.

In the field trials of the Universal Exposition for 1878 there were but four entries of binding reapers, and these were all from the United States. The very considerable increase in the manufacture of these machines in 1889, as compared with 1878, was evidenced in

the greater number of competitors, representing the United States, Canada, and France. The following is a list of entries:

Walter A. Wood, Hoosic Falls, New York, United States.
McCormick Harvesting Machine Company, Chicago, Illinois, United States.
Johnston Harvester Company, Batavia, New York, United States.
Samuel Johnston & Co., Brockport, New York, United States.
D. M. Osborne & Co., Auburn, New York, United States.
Massey Company, Toronto, Canada.
Harris & Sons Co., Brantford, Ontario.
Pécard Brothers, Nevers, France.
Hurtu, Nangis, France.
A. B. Albaret, Liancourt-Rantigny, France.

The two latter of the French machines are copies of the McCormick. The first trial was in cutting wheat, each machine having a plot drawn for by lot. The plots were in some cases unequal as to the state of grain, Wood and McCormick meeting with plots badly lodged in certain places. In the afternoon of the 19th the binders worked in oats, and again the Wood and McCormick met with lodged plots. The best work was made by the Wood, Massey, and McCormick machines.

W. A. Wood exhibited and worked—but not in competition—a binder which employed straw as the binding material. It was a most ingenious machine and worked very well, and will be described further on in connection with the more particular mention of the several binders. On the 22d, in the dynamo-metrical trials, the following binders were tested: W. A. Wood, McCormick, Albaret, Hurtu, and Johnston Harvester Company.

The dynamo-metrical tests were carried out by Professor Ringlemann with a dynamometer, devised by himself, of peculiar merit.

These experiments showed that the force required to move the machines was from 64 to 85 kilos, giving a mean of 77 kilos. The traction with the various parts in motion, but not handling grain, ranged from 104 to 132 kilos, giving a mean of about 118 kilos. The draft, with the machines in full work, cutting grain, was from 164 to 189 kilos, giving a mean of about 173 kilos.

The following statement of the weights of the machines, together with the width cut by each, will be interesting in this connection.

Machines.	Weight.	Width of cut.
	Kilos.	*Meters.*
Hurtu	700	1.55
Massey	710	1.50
Pécard Bros	700	1.52
Johnston	660	1.50
Johnston, S.	560	1.50
Harris & Son	680	1.85
McCormick	760	1.50
Wood	550	1.50
Do	670	1.60
Do. (straw binder)	600	1.60
Osborne	680	1.50
Albaret	750	1.368

In 1873, at the Universal Exposition at Vienna, a binding harvester was shown in the American section. It was the first model of the Wood machine and was exhibited later, in 1876, at Philadelphia and in 1878 in Paris.

The Wood binder exhibited at Vienna in 1873 was still in a state of infancy, the inventor not wishing even to work it in the field, but was content to illustrate its nature by binding a bundle of papers. His intention was then to merely illustrate the principle of a self-binding machine, which he intended to work out and bring to a condition of practical utility. It was thus only an experimental machine, and was shown in the same way as was the straw-binder at the late Paris Exposition. Although the wire binder was rejected by many of the recognized experts and prominent manufacturers of that time as an impractical device, but a few years elapsed before it had become a merchantable machine. and many thousands had been sold in various parts of the world.

The self-binders which took part in the trials at Philadelphia in 1876 were the McCormick, McPherson (Caledonia, New York), and Wood machines. The Wood machine (the invention of S. D. Locke) was an improved form of the one shown at Vienna 1873. All the machines bound with iron wire.

In 1877 the Royal Society of Agriculture of England organized a trial of binding reapers at Liverpool; but no machine was deemed worthy of a prize. In 1878 the society opened the second special concourse at Bristol, and this time the prize was awarded to the McCormick machine, and at the same time this machine also took first rank in the trials on the field of Marmont, France, in connection with the Exposition of that year.

At the Universal Exposition of 1878, at Paris, eight self-binding reapers were shown: Walter A. Wood, Anson Wood, McCormick, Osborne, Johnston, and Aultman (American section); Howard and Neal (English section).

The Neal and Johnston machines bound with twine; the others employed a very fine iron wire.

Four machines, all from the United States—Aultman & Co., McCormick, Osborne, and Walter. Wood—were entered for competition in the trials on the field of Marmont on the 22d of July, 1878, where they gave very satisfactory results.

The binding with wire was a decided disadvantage, however, because the band was liable to injure the threshing machine, or, getting into the straw fed to animals, or in flour, would lead to serious results. To obviate these objections, the instrument employed in cutting the bands as the sheaves were fed into the thrashing machine, was provided with an attachment to seize and retain the wire.

To sum it up briefly, the binders of the Exposition of 1878 were heavy and somewhat cumbersome and while working fairly well at

the field trial at Marmont, they were lacking in many details of practical work.

The vital objection to their use was that particles of the steel wire bands which, in spite of all efforts, would escape with the straw or wheat were dangerous not only in the forage of animals but also in the flour manufactured from the grain harvested by these machines. A further objection was the placing of the complicated binding device below the binding table in such sort that it was difficult to adjust the wire if it were broken either by too great tension or weakness at some point in the wire, which was very seldom regular in diameter or strength.

The trials of 1878 at Marmont had excellent results in demonstrating that binding reapers were capable of practical work and in leading agricultural societies to institute trials and exhibitions of binders, and by these means widely advertising the merits of the machines and also directing attention to the defects to be remedied. This has contributed to the rapid progress of the binding reapers until now they have certainly reached a perfection which leaves little to be desired.

The machines of to-day are distinguished from those of ten years ago in two principal respects: (1) the bands are of a vegetable material which present none of the objections attaching to the iron wire; (2) the device for knotting the band is placed above the binding table and can be easily seen and adjusted.

The binding reapers in general construction are similar to those of 1878 so far as relates to the reel, the grain table, and elevators. Examining these machines, the Wood binder may be taken as a type, as it was the one that secured the first prize at the international concourse at Mitry in 1887 and received one of the grand prizes at the late Paris Exposition, taking first honors.

The single carrying or main wheel of the machine is solid with an inner cogged wheel which governs by means of a follower the transmitting shafts; the grain table, the elevating aprons (and often the revolving reel) are operated by endless chains; and it is the same in the case of the binding mechanism.

These chains pass over tension rollers properly disposed and which insure uniformity in the transmission of the force.

In the older models, the sickle was driven by means of a balancer parallel to the axle of the machine; the balancer was put in motion by a coupling rod and pitman placed at the rear. This arrangement is only employed now in the McCormick machines; in other machines the sickle is commanded directly by the coupling rod in front of the main or bull wheel.

The reel is arranged to run at two rates of speed. It may receive a rapid movement for certain crops and a slow movement when working in overripe grain. The axis of the reel may be displaced

in the vertical plane to approach or withdraw from the sickle in accordance with the height and condition of the grain or the wind which will often tend to throw the grain in a direction away from the table. The movement of the wings of the reel should be sufficiently rapid to throw the cut grain well onto the table to prevent its clogging the sickle and the elevating aprons.

The elevator absorbs a certain amount of mechanical force; it raises the grain generally about 1 meter (3 feet); and estimating at 6,300 kilos the weight of the crop to the hectare of wheat, giving 25 hectoliters, it is evident that we have an absorption of 6,300 kilogrammeters by the elevator; with a crop yielding 20 hectoliters the force expended is 7,400 kilogrammeters to the hectare. In view of this, certain manufacturers have sought to diminish the draft by reducing or suppressing the elevator.

To do satisfactory work it is necessary that the grain should be regularly placed in the bundle. To secure this result the various binders are provided with different mechanisms. On the horizontal table, back of the sickle and parallel with it, is a large wooden frame provided with a screen-forming apron. The frame can by different inclinations be made to approach or withdraw from the sickle according to the height of the grain and has the effect of keeping the grain uniformly placed. After leaving the elevator the grain is taken on the binding table in front of the binding apparatus by two devices; the one on the head side of the bundle is formed by a single plate which may be inclined more or less; the other on the butt side may be inclined and also made to approach the former.

The latter apparatus, called an equalizer, has an alternating movement in the Wood machines. It is a revolving plate, turning in the same plane as the table and communicating an oscillating movement to a grooved plank. These grooves in their descending movement push the base of the grain regularly, making it descend as fast as the heads and presenting the grain to the binder in proper shape.

In most other machines (Osborne, Plano, Howard, McCormick, Buckeye, Johnston, Hornsby, etc.) the alternating equalizer is replaced by a small endless apron provided with wooden slats, passing over rollers, of which the axis is perpendicular to the table. One of these rollers may be made to approach the first mentioned plate to regulate the passage of the grain. The endless apron is placed at any desired inclination by means of a lever placed within easy reach of the operator. With this system the position of the band on the sheaf can be regulated at the same time.

In the Wood machines the position of the band is regulated by moving the entire binding device, which for this end may be displaced laterally by means of a conveniently placed mechanism.

The binding apparatus is operated by means of an endless chain and is too complicated to be described in the space at command.

Many of the machines have the frame work of the table of steel (McCormick), others have the frame of the binding mechanism of steel (Johnston, Buckeye, etc.), and finally certain machines have no wood at all in the frames which are constructed entirely of steel (Osborne). In the Osborne machine the horizontal table behind the sickle is protected by an under plate which slides on the stubble, and protects the endless apron.

The sheaves are thrown out separately and far enough to be out of the way of the machine in the following round. Certain of the older forms discharged the sheaves too abruptly, causing more or less shelling, especially in case of over-ripe grain. To obviate this difficulty the manufacturers have so constructed the discharging mechanism that the sheaf is caused to fall on its butt. which results in largely preventing the shattering of the grain.

The sheaves distributed over the field required considerable hand work to collect them into shocks. This labor has been greatly reduced by adding to the binders an apparatus for carrying the bundles until a sufficient number are collected and then discharging them together. The first arrangement of this kind appeared in August, 1884, in connection with the Hornsby binder at the great concourse at Shrewsbury. Soon all the machines were provided with bundle carriers varying somewhat in construction.

In the Hornsby binder the bundle carrier is formed of a fork and an articulated support capable of vertical movements. The cradle thus formed will hold five bundles, and may be liberated by a lever worked by the foot of the conductor, allowing the bundles to fall side by side gently to the ground.

In the Howard binder, the cradle is of plates and is mounted on a central axle, a backward inclination deposits the bundles gently on their butts.

An arrangement similar to this was attached to the Johnston binder in 1886, and the Buckeye of Aultman. The Howard in 1887 was provided with a bundle, carrier which approached very closely to that of the Hornsby system just described.

In the Wood binder the bundle-carrier is formed by six horizontal steel arms slightly curved upward at their extremity.

The bundle-carrier permits a considerable reduction in hand labor—two men sufficing with its use to shock the grain after one binder. It presents also an advantage whenever it is not desirable to bind the crop for any cause; the binding apparatus is then removed and the grain collects on the bundle carrier and may be disposed in large masses to be afterwards bound by hand or collected without binding.

For certain other crops (lucern, flax, etc.), the binder may also be employed by removing the binding apparatus and retaining the bundle-carrier or adding a special carrier.

In the Wood binder, to the carrier, is added a rake which retains

the material coming from the elevating aprons, while the mass collected is being deposited.

The width of the cut varies from 1.30 to 1.85 meters. The Johnston "Continental" is constructed of two sizes; the one cutting 1.75 meters, to be drawn by three horses, and intended for extensive operations; the other cutting 1.50 meters, to be drawn by two horses and intended for smaller holdings. It is generally claimed by manufacturers that two horses are sufficient to work their binders, but experience shows that three will ordinarily be required.

In Russia, on the estate of Ivan Pleshanow, the fields are harvested by five McCormick machines following one after the other, and each drawn by two camels. (See Fig. 75.)

In transporting the binding harvester, the tongue is taken off and placed parallel with the sickle, the machine is then mounted on a light two-wheeled truck, and may be easily taken from place to place or through narrow gateways, etc. With certain machines (Albaret, Johnston, "Continental," Buckeye) the transporting trucks may to some extent be dispensed with—these being made to occupy a narrower space by folding up vertically.

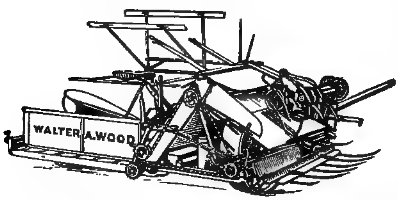


FIG. 67.—Steel wheel binder, 1889. W. A. Wood.

To conclude, the binding harvesters as now constructed do most excellent work, and have practically supplanted the simple harvester. On the average, there are not more than 3 sheaves in 100 that are not well bound, and the waste attending hand labor is avoided, and the great difficulty of securing such labor at the proper time obviated. The addition of a bundle-carrier, reducing the hand labor necessary to shock the grain, makes it possible for the farmer to harvest his crops at the right time and with the least expense.

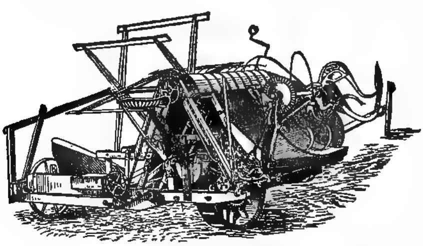


FIG. 68.—Wire binder, 1878. W. A. Wood.

PARTICULAR NOTICES OF AMERICA MACHINES.

The three twine binders exhibited by Mr. Wood, at Paris, in 1889, represent the best models of the present time, and each in its special place meets and obviates some of the practical objections which experience in the field had developed. Taking these machines up in order, we begin with the regular three-apron six-roller binding harvester. This is the machine which in general form and construction is adopted by all the leading manufacturers of England, France, and

the United States, and to which all builders, except Mr. Wood, still adhere exclusively. Mr. Wood's machines of this class differ from all others in one essential point, namely, the binding apparatus. All the others practically utilize what is known as the Appleby knotter, while the Wood machines are equipped with a device known as the Wood knotter, and for which he claims certain advantages, as follows:

The action of the trip lever which, when the bundle is ready to be tied, arrests the movement of the packers at the moment when the knotter arm and binding mechanism begin their work. This constitutes an essential difference between Mr. Wood's and any of the other machines exhibited, and it is claimed that this results in economizing the motive power at the moment when the machine is called upon for its greatest efforts. The knotter of this machine does its work close to and in direct contact with the bundle, so that none of the compression is lost. The discharge arms work in the same manner as a fork in the hands of a workman, projecting the bundle forward toward the edge of the binder deck, and then rising and with drawing backward to eject the following bundle. This movement contrasts with the rotary discharge of other machines. Other equally important details of these machines might be dwelt upon if space permitted.

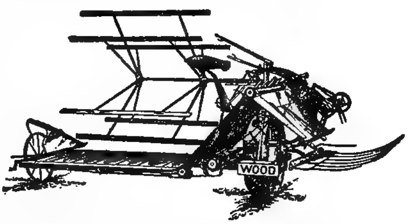


FIG. 69.—Single-apron binder, 1889. W. A. Wood.

It may be well to state also that practical experience in the field has demonstrated the existence of certain defects in the form and construction of the harvester above described, and which other machines have in common with that of Mr. Wood's. They are the necessity of using three aprons in carrying and elevating the grain, and six rollers for supporting the same. The use of the upper elevating canvas necessitates a rear support for the rear end of these rollers, and this constitutes what is known as the closed rear machine. Long grain is of necessity compelled to fold back the heads in passing this obstruction, and in this way the straw is broken and much grain threshed out and lost. The care also of these three aprons and the necessity of running them tight on their rollers give great trouble and consume a large amount of motive power. To obviate these grave defects Mr. Wood has constructed and exhibited what is known as the single-apron open-rear harvester. This is a long step in advance, completely obviating all the difficulties presented by the old form of construction, as absolutely proved by experience in the heaviest and most difficult crops. In its binding and discharging devices and other details it has all the advantages of the other machines.

Again, there has been a recognized demand for a machine lighter and simpler and more easily managed than any of the above, and which two small horses could draw without difficulty on rolling upland and hillside farms. To meet this demand Mr. Wood has brought out after some years of experiment, and exhibited at Paris, the so-called "rake elevator," a machine which is itself an open-rear single-apron binder, but of peculiar construction. In it he has abandoned many of the awkward and cumbersome features of its predecessors. It has but one short apron, carrying the grain across the platform, where it is seized unerringly by a light rotary rake, which acts at once as an elevator and compressor, driving the grain immediately into the jaws of the binder, which in turn by a simple and efficient device ties and discharges in one movement.

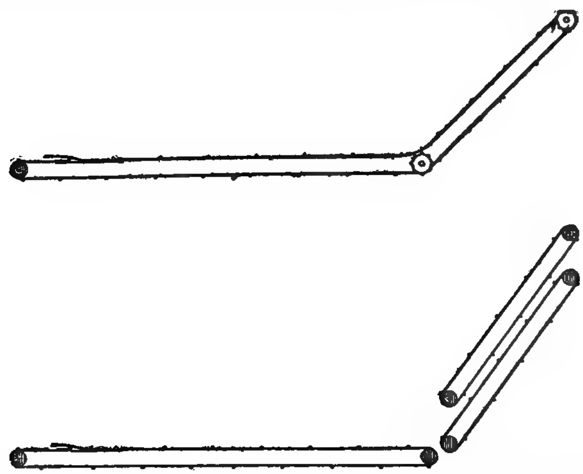


FIG. 70.—Arrangement of Walter A. Wood's single apron, and of harvester aprons as ordinarily constructed.

In this machine are combined all the advantages of those above referred to, with some which none of these possess. It has but one short apron and two rollers, is completely open at the rear, and can handle the longest and heaviest straw; and by its peculiar method of combining two functions in one, namely, the elevating and compressing in one act and the binding and discharging in one act, it presents itself at once as the lightest, simplest, and most efficient machine extant.

Finally, the straw-binding harvester, of which so much has been said, and which may not inaptly be called the machine of the future, closes the list of the Wood binders. He has attempted in this machine to prove that it will be possible to save to the farmers in this country the expenditure of the twelve to fifteen million dollars annually necessitated by the use of twine in binding their crops. Its success in the field trials at Noisiel, where it was only entered as an

experimental machine, and its performance elsewhere, abundantly prove its value and its entire practicability; and indicate that its introduction to the commerce of the world as a merchantable machine will not be long delayed. Its ultimate perfection will be looked forward to with interest by agriculturists in all lands.

The binder resembles the ordinary Wood machine. Behind the seat is found a sort of semicylindrical box, inclined at 45°, in which is placed the straw for the bands, cut at the desired length. The straw should be straight and slightly moist. A very ingenious mechanism moving periodically withdraws from the box bunches of straw and twists them into an endless rope, which passes out at the top and passes above the binding apparatus. When the straw is well prepared the machine works very well. It would seem at first thought that the ideal would be a mechanism which would take the material for the bands from the cut grain. It is evident, however, that the grain in the portion used for the band would be largely lost, and, as has been well remarked by Mr. Wood, a small area of rye would furnish material sufficient to bind an immense area of wheat or other crop. Each farmer could thus provide himself at trifling cost with the material necessary to bind his crops, and be independent of any syndicate controlling the manufacture of twine, and that has and is attempting to still further increase the price of this, at present, indispensable article.

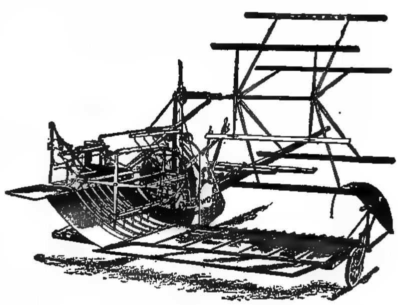


FIG. 71.—Rake elevator binder, 1889, W. A. Wood.

The McCormick Harvesting Machine Company, of Chicago, has perhaps the largest output of machines of any manufactory in the United States or the world, and is also one of the oldest, having been founded in 1831, by the elder McCormick. The record of the company has been a brilliant one both under the elder McCormick, whose death occurred in 1884, and under his son and successor, Mr. Cyrus H. McCormick. In 1878 the McCormick binder, exhibited then for the first time, took first rank at the trials of Marmont, and was awarded the Object of Art.

In the Exposition of 1889 a grand prize was awarded to this company by the Exposition authorities and a gold medal by the Government as a result of the field trials at Noisiel.

The binder of 1889 has been much modified and improved, and scarcely recalls the old style of 1878. The frame of the new binder (Fig. 72) is entirely of steel, giving it both solidity and lightness. In the cutting apparatus the bar may be lowered almost to the level of the ground to take up fallen grain. For the rest of the machinery

its simplicity and the great reduction in number of gearings is at once apparent. This is especially noticeable in the knotter, which has been much improved and the number of pieces reduced to seven.

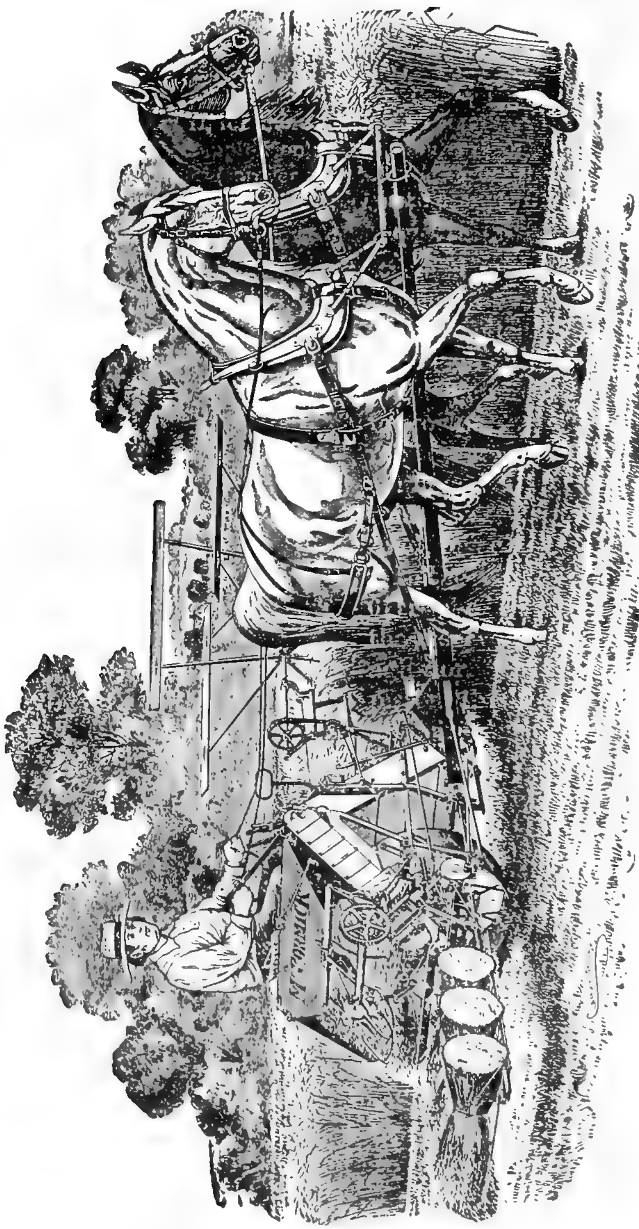


FIG. 72.—The McCormick binder, 1889.

Before being bound the sheaf is seized and compressed by two arms, and the knot is made at the moment when the compression has reached its limit. The machine is provided with a bundle carrier,

with which the bundles may be deposited separately or several together.

The flattering success at the July trials of the Toronto binder of the Massey Manufacturing Company, Toronto, Ontario, should be a source of great gratification to Canadians. The machine entered at the trials by this comparatively new company was only excelled by the Wood machine, receiving in fact equal recognition in the awards, viz, an Object of Art. A cut of the Toronto No. 4 is given at Fig. 73.

Chief among the many highly useful machines exhibited by the Johnston Harvester Company, of Batavia, New York, was the "Continental" light steel binder, one of the most perfect machines of its kind ever exhibited. By the use of fine channel steel for the

FIG. 73.—Toronto binder, Massey Manufacturing Company, Toronto, Ontario.

frame and the finest steel and malleable castings, the weight has been reduced considerably below the similar machines of other manufacturers, rendering it especially valuable for hilly or rolling lands.

These machines are quite extensively sold in Europe and Asia, and in this connection attention is drawn to an interesting illustration (Fig. 75) representing a Johnston Harvester Company's binder as used in southeastern Russia. The novel feature in this illustration is the use in drawing the machine of Bactrian camels, which powerful animals are the favorite means in that country for this purpose. Reference has already been made to their use with the McCormick machines in Asiatic Russia.

Attention has already been called to the fact that the Osborne Binder Company was the first to adopt the all-steel frame, now generally employed by all manufacturers. The Osborne machines are

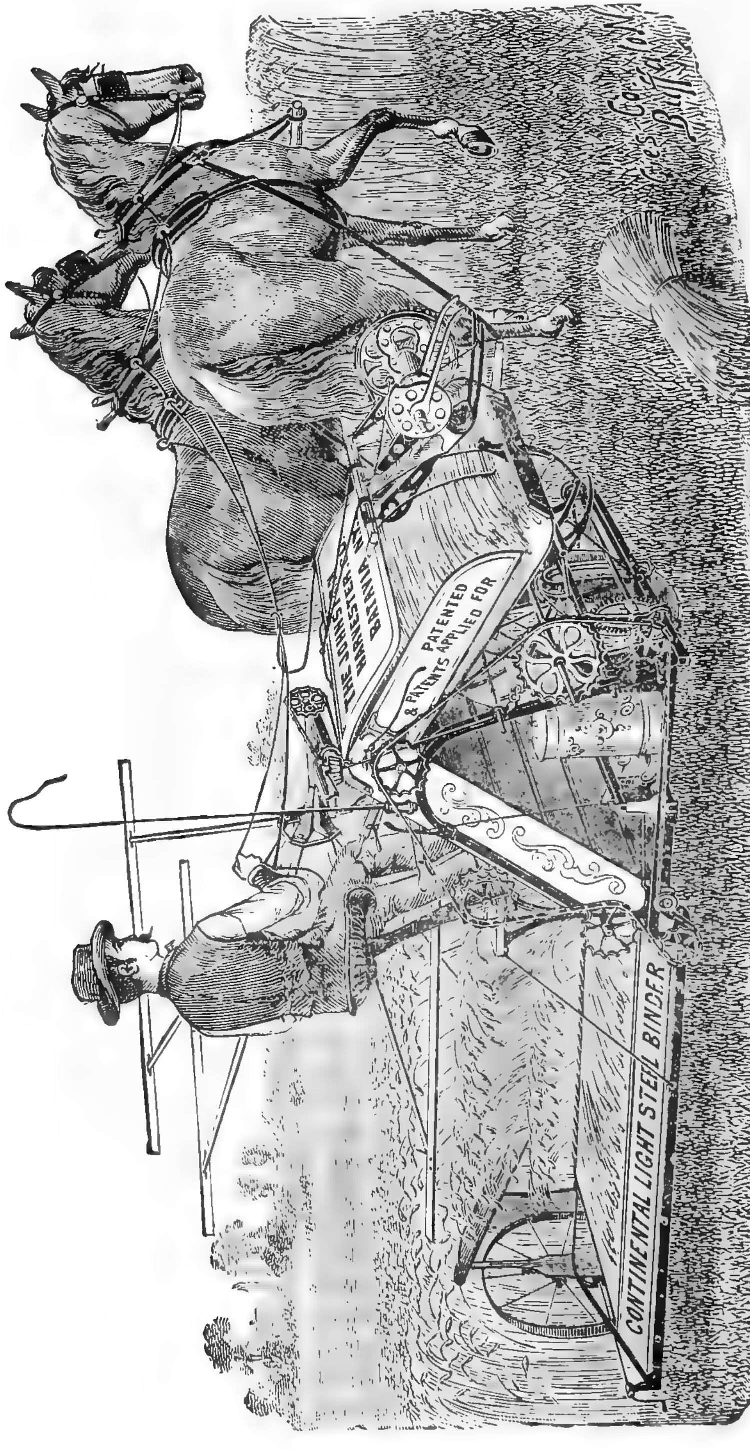


FIG. 74.—Continental light steel binder. Johnston Harvester Company.

simple of construction, reliable, and durable, and are justly popular. The "Osborne, Jr." binder and harvester is shown in Fig. 76.

The Osborne binder can be made to bind from 4 to 27 inches from the butt as desired; the reel is controlled by a single lever and may

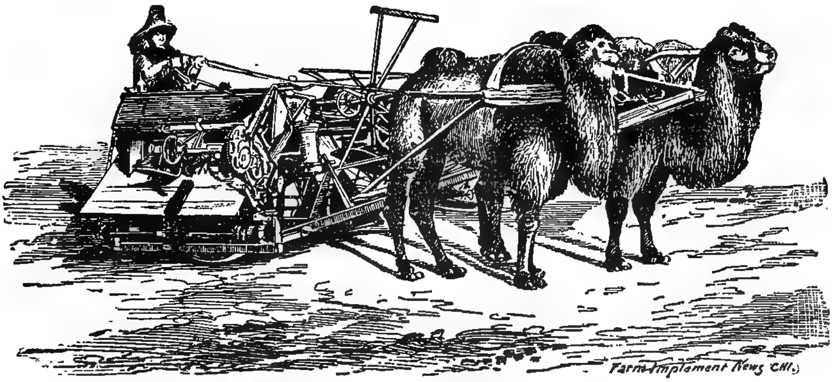


Fig. 75.—Harvesting in southeastern Russia with Johnston's binder.

be easily adjusted. The Osborne transportation truck is a model of its kind, the driver being able to turn his team in line with the cutting apparatus without detaching the pole.

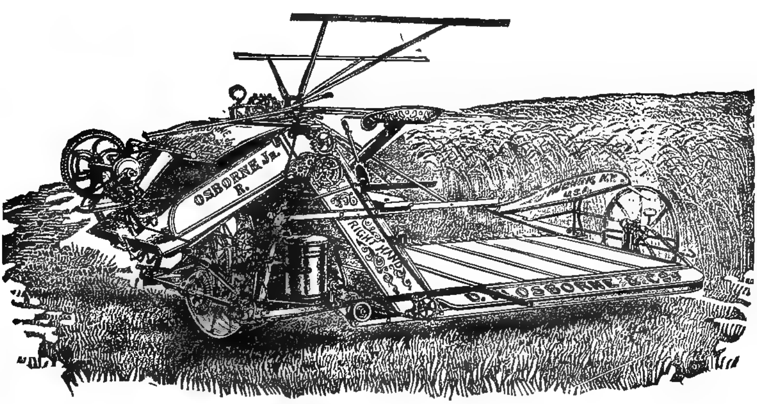


Fig. 76.—"Osborne Jr." binder. D. M. Osborne & Co.

The important feature of the Plano binder, which is an all-steel machine (Fig. 77), is the chain drive employed, instead of the cogged gearing, to transmit motion from the bullwheel to the various parts of the machine. It is held that by the use of chains for

transmitting power, the racking and twisting of the harvester frame when used on rough ground makes no appreciable difference in the draft, the cramping in the main gear and spur pinion being wholly avoided; also the excessive friction and wear of these parts.

The following is a list of the prizes awarded to successful competitors in the Noisiel trials:

Object of Art.—Walter A. Wood (United States of America): Massey Manufacturing Company (Canada).

Gold Medal.—Johnston Harvester Company (United States of America); McCormick (United States of America); Hurtu (France).

Silver Medal.—Pécard (France); Harris (Canada).

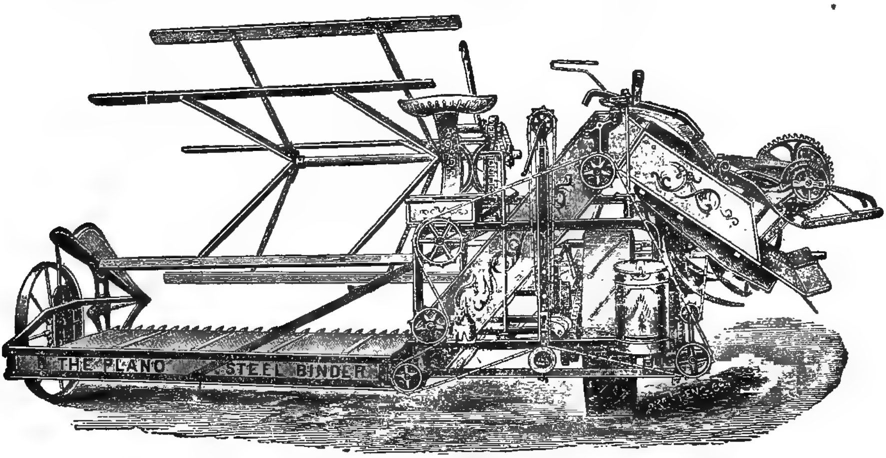


FIG. 77.—Plano binder. The Plano Manufacturing Company.

SIMPLE HARVESTERS AND COMBINED HARVESTERS AND MOWERS.

This class of harvesting implements have been, as already noted, largely supplanted by the binding harvesters, but they are still called for by small farmers whose acreage does not warrant the purchase of the more expensive binder. There is also more or less demand for a combined machine which may be employed, as occasion may require, either as a simple mower or as a harvester.

With these machines, as with the mowers, few important changes have been made since 1878, save such as have taken place in agricultural machinery generally, viz, reduction in weight and traction and changes and improvements in minor details.

A table is presented herewith giving the competitors in the field trials, together with the weight and width of cut of the several machines entered.

Simple and combined harvesters entered at the Noisiel trials.

Name of exhibitor.	Countries.	Weight of machine.	Width of cut.
Simple harvesters:		*Kilos.*	*Meters.*
Victor, Rigault (Express No. 8)	France	460	1.35
Wood, W. A.	United States of America	360	1.50
Albaret	France	600	1.52
Harrison MacGregor & Co. (Albion No. 4)	England	530	1.50
Hurtu	France	500	1.45
Johnston Harvester Company	United States of America	485	1.55
Bradley & Co	do	375	1.45
Combined harvesters:			
Victor, Rigault (Excelsior No. 3)	France	480	1.27
Johnston Harvester Company	United States of America	550	1.60

Each machine was required to cut an area of 36 ares of wheat. The work was finished in a time varying from 35 to 53 minutes, averaging about 40 minutes. The trials which followed with oats gave similar results.

On the 22d of July the dynamo-metrical trials were made with the following machines: Rigault, Johnston, Albion, Bradley, and Albaret. The traction in full work varied only slightly, from 109 to 138 kilograms.

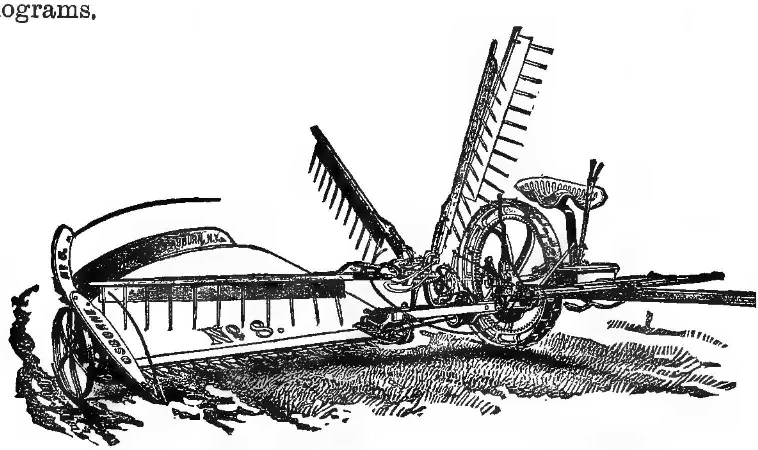


FIG. 78—Osborne No. 8 reaper. D. M. Osborne & Co., Auburn, New York.

The successful competitors in these trials are the following:

Gold Medal.—Walter A. Wood (United States); Harrison MacGregor & Co. (England).

Silver Medal.—Bradley & Co. (United States of America); Victor Rigault (France); Johnston Harvester Compamy (United States of America); Hurtu (France).

AMERICAN MACHINES.

The No. 8 Osborne reaper is one of the best of its class, and includes the essential points of a serviceable and durable machine. The drive wheel is broad to prevent sliding on hillsides. The rake can be set so that every fourth rake, every other one, or all, can be used to rake off, according to the grain. The platform can be brought to an upright position for transportation or storage.

The Wood sweep-rake reaper, as exhibited in 1878 (Fig. 79), developed certain faults in construction which have disappeared in the automatic sweep-rake light reaper shown at the Exposition of 1889 (Fig. 80).

In the new light reaper of 1889 the weight and traction have been reduced to the last practical point. The sweep rakes are con-

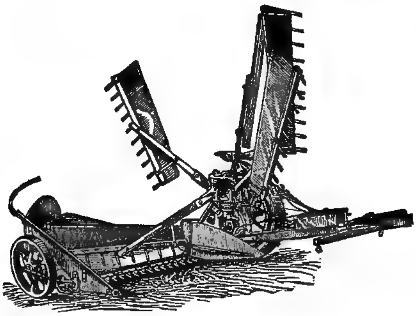


FIG. 79.—Sweep-rake reaper. 1878. W. A. Wood.

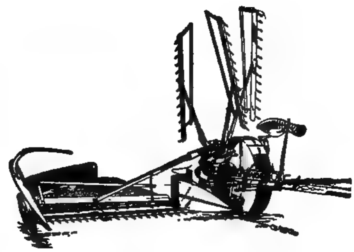


FIG. 80—Light reaper. 1889. W. A. Wood.

trolled by a novel and automatic device, by means of which all or any of the rakes may, by a touch of the hand, be made to act either as reel bats or rakes. The whole platform may be tilted to any

FIG. 81.—The Daisy reaper. McCormick Machine Company.

required angle, or folded vertically, so that the machine may pass through a narrow gateway.

The McCormick light "Daisy reaper" is shown at Fig. 81. It is

used only in cutting any growing crop that is desired to be left in bundles unbound upon the ground. Its special features are that the bull wheel is one of the largest and has the widest face of any of the single reapers, and the whole machine is driven by the main axle, obviating the use of gearing near the rim of the wheel.

The cutting parts may be easily adjusted to take up grain or crops in any condition, and are of the best material.

MOWERS.

The height of perfection reached by this class of machines in 1878 left little opportunity for striking improvements in the machines exhibited in 1889.

Their mechanism has been considerably simplified, however, and numerous improvements of a minor nature have been made. The cutting apparatus is much more solid, and various devices have been added to secure easy and satisfactory lubrication of the wearing parts. The width occupied by the machine in transportation may be reduced by raising the sickle, etc.

The majority of the mowers present among themselves a close similarity, few of them being distinguished by striking peculiarities. The latest model of the Wood mower, however, possesses a tilting device by means of which, without absolutely raising or lowering the cutter bar, the operator may, by a touch, raise or lower the points of the guards, thus changing the angle of inclination of the bar. The following table gives the manufacturers competing in the field trials at Noisiel, and also the weight and width of cut of the several machines:

Mowers entered at the Noisiel trials.

Name of exhibitor.	Country.	Weight of machine.	Width of cut.
		Kilos.	*Meters.*
Hurtu	France	350	1.20
Wood, W. A	United States	328	1.30
Samuelson-Dexter	England	360	1.25
Samuelson & Co	do	358	1.28
Harrison, MacGregor & Co., Albion, No. 4	do	330	1.30
Harrison, MacGregor & Co., Albion, No. 5	do	330	1.30
Victor Rigault, Excelsior, No. 3	France	325	1.27
Victor Rigault, Express, No. 7	do	330	1.27
Bamlett, No. 4	do ?	...	...
Bamlett, No. 5	do	375	...
Tritschler Sons	do	300	1.28
Massey	Canada	295	1.28
Harris & Herlicq	do	230	1.27
Albaret	France	350	1.30
McCormick	United States	295	1.25
McCormick, No. 3	do	265	1.15
Johnston Harvester Company	do	280	1.25
Pécard Frères	France	325	1.30
Japy Frères, No. 1	do	310	1.20
Japy Frères, No. 2	do	340	1.20
Japy Frères (Paradoxale)	do	240	0.90
Bradley & Co	United States	290	1.25

Prizes were awarded, as a result of the trials, as follows:

Gold Medal.—Walter A. Wood (United States), Harrison, MacGregor & Co. (England).

Silver Medal.—Hurtu (France), Rigault (France), Japy (France), Samuelson (England).

AMERICAN MACHINES.

In connection with the illustration (Fig. 82), may be mentioned one of the novel and desirable features of the Osborne No. 4 Mower, viz, the loose and flexible cutter bar. The outer end of the bar will drop 2½ feet into a ditch or raise in like degree in passing over a knoll.

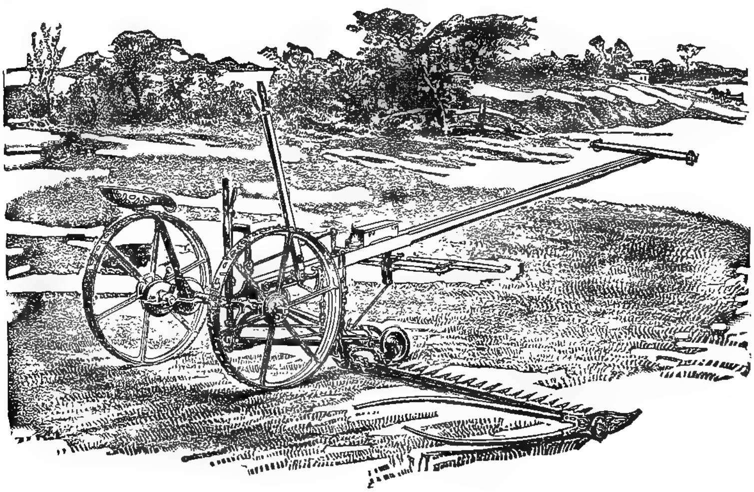


FIG. 82.—No. 4 Osborne mower. D. M. Osborne & Co.

The Wood inclosed gear mower of 1878 (Fig. 83) embraced all the essential features of the machine as made to-day. One feature only has been added, namely, the attachment of the tilting device to the cutter bar, by means of which the angle of the guards may be readily changed at will.

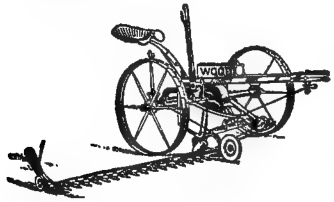


FIG. 83.—Inclosed gear mower, 1889. W. A. Wood.

One feature peculiar to the Plano mower of the Plano Manufacturing Company, Chicago, Illinois (Fig. 84), may be noted, viz, the connection of the braces to the finger bar is such that the points of the guards are always held firmly down to their work, but when they strike immovable obstructions they will roll or turn up and pass freely over the obstruction, instead of digging into it and stopping the machine.

The McCormick steel mower No. 3, the machine exhibited at the Paris Exposition, is represented at Fig. 85. The simplicity of the

gearing of this machine, the fact that every bearing in its cast main frame is bored at one operation and fitted with removable bushings

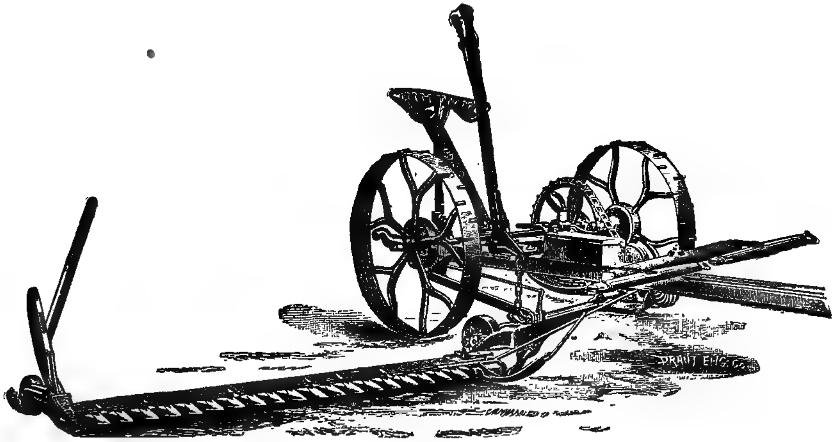


FIG. 84.—The Plano mower. Plano Manufacturing Comp . y.

of Babbitt metal, the hickory pitman with which it is fitted, the great care taken with its cutting apparatus, the strong carrying springs which largely place the weight of the cutter bar upon the

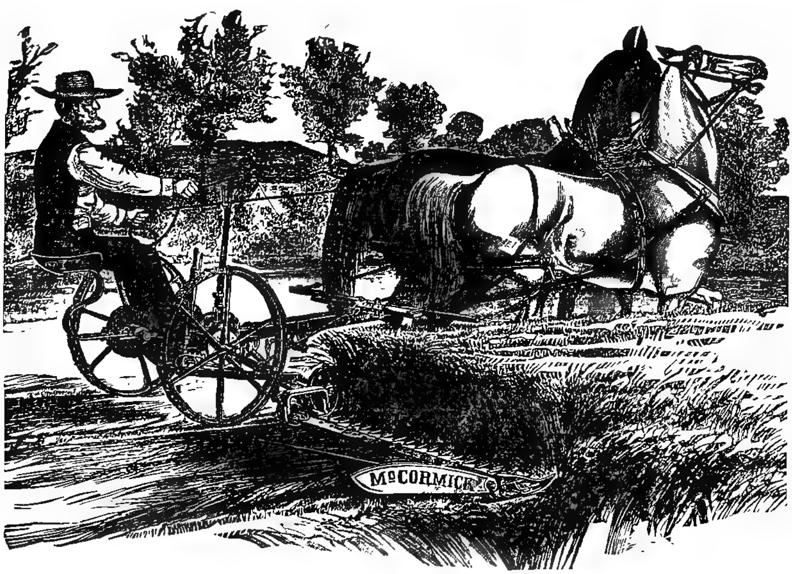


FIG. 85.—No 3 mower. McCormick Machine Company.

wheels, the draft attachment, the lead wheel always resting and running upon the ground, are special features of this mower.

HAY PRESSES TAKING PART IN THE NOISIEL TRIALS.

Steam Presses—These were exhibited by Albaret (France), Whitman (United States of America), Samuelson & Co. (England).

The first two construct bundles in the form of parallelopipedons, the latter cylindrical bundles.

Power Presses—Tritschler fils aîné (France).

This press is the Whitman half-circle horse press, and the credit for the award of a gold medal mentioned below should accrue to the Whitman Company.

Hand Presses—Guitton (France); Lacoux, two machines (France).

The bundles constructed by the last four are parallelopipedons.

Prizes were awarded as follows:

Object of Art—Whitman & Co. (United States of America), for steam press.

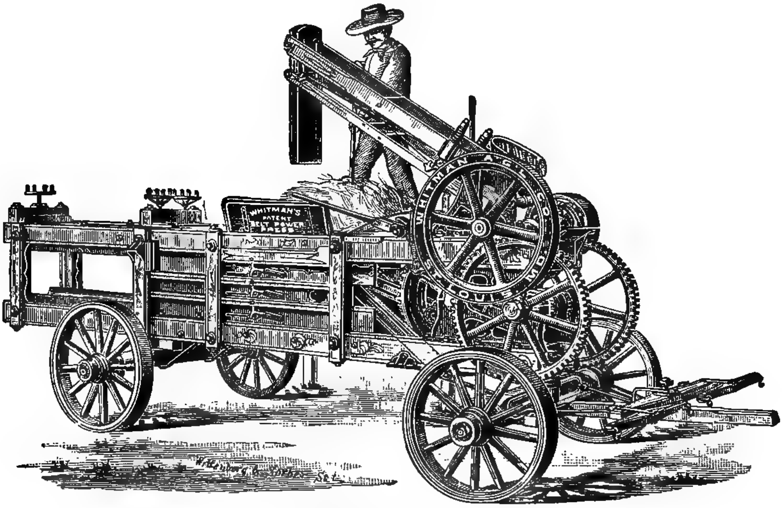


Fig. 86.—Steam or belt power press. Whitman Agricultural Company, St. Louis.

Gold Medals—Tritschler (France), for horse or ox press (the Whitman half-circle horse press); Guitton (France), for hand press.

Bronze Medals—Lacoux (France), for hand press; Vidal (France).

The well and favorably known Whitman Agricultural Company, of St. Louis, shipped two hay presses to Paris, but were unable to obtain the space required for more than one style—the New Steam or Belt Power Press, figured above. (Fig. 86.)

This press was entered in the Noisiel field trials, where it did more than double the work in the same time of any other press in the trials, and obtained a gold medal in the Exposition and a grand prize (object of art) in the Noisiel trials. This press was first placed on the market three years since and has met with very flattering success, having received first prize wherever exhibited.

The two hand-presses of forage exhibited by M. Guitton are here shown. Fig. 87 represents the horizontal style and Fig. 88 the vertical style. These machines were entered at the Noisiel trials and were awarded a gold medal.

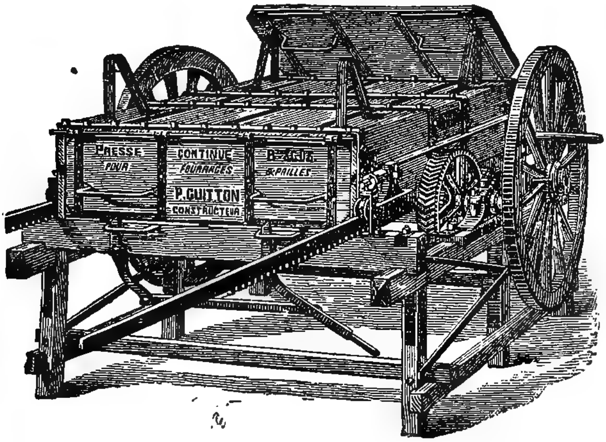


Fig. 87.—Horizontal hand forage press. Guitton, France.

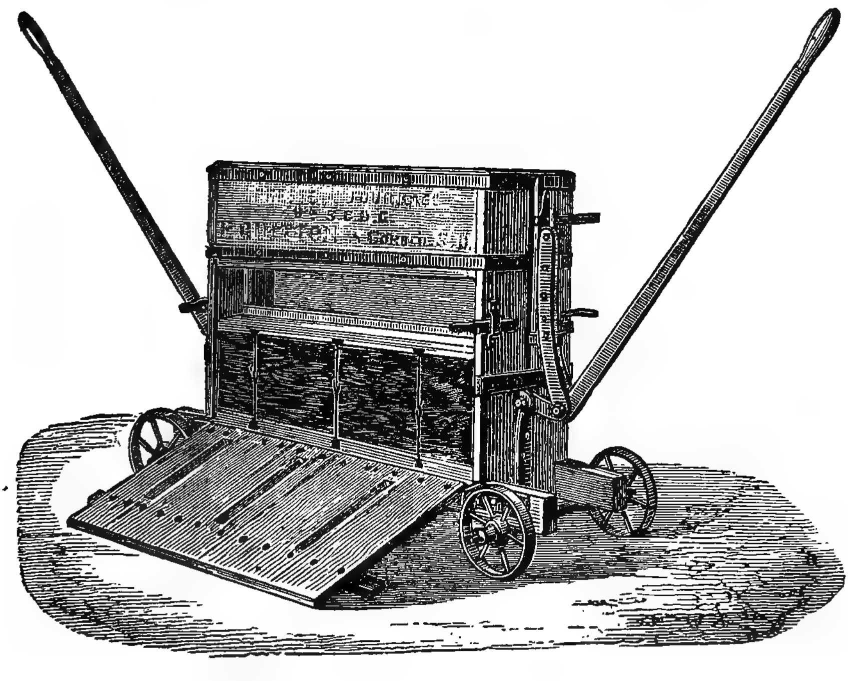


Fig. 88.—Vertical hand forage press. Guitton, France.

The forage presses of Samuelson & Co., of Banbury, England, are the same as those manufactured by Th. Pilter, of Paris, and

construct cylindrical bundles. This press is made entirely of iron and steel. (Fig. 89.)

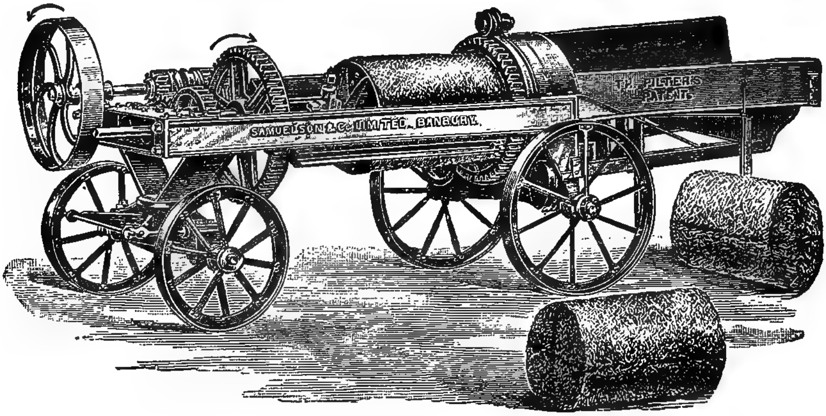


Fig. 89.—Pilter's hay and straw press. Th. Pilter, Paris, France.

The Whitman forage press exhibited at the Exposition and entered at the Noisiel trials by M. Tritschler, of Limoges (Haute-Vienne), is represented at Fig. 90.

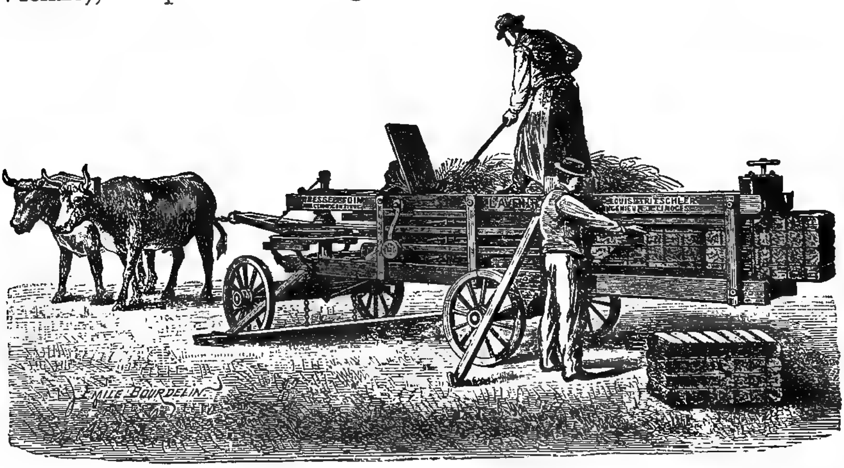


Fig. 90.—The Whitman forage press. Exhibited by Tritschler.

SOME NEW IMPLEMENTS OF AGRICULTURE AND FORESTRY.

THE "STRAWSONIZER."

A machine that has attracted great attention and many complimentary notices in England and also at the late Paris Exposition is the improved broadcast distributor known as the "Strawsonizer" after the inventor, Mr. G. F. Strawson, of Newbury, Berks, England.

This machine is intended for three classes of work, first, to spray

insecticides; second, to sow seed broadcast, and, third, to distribute artificial fertilizers, such as nitrates and superphosphates.

The principle of the machine is that as the solids or liquids are fed out of a hopper or tank they are subjected to a strong blast of air. The air blast is produced by a fan which is given a velocity of 3,600 revolutions per minute by an ingenious system of multiplying gearing from one of the traveling wheels of the machine. In the distribution of dry substances, seeds, or powdered insecticides or fertilizers, the blast is further directed by a flanged plate over

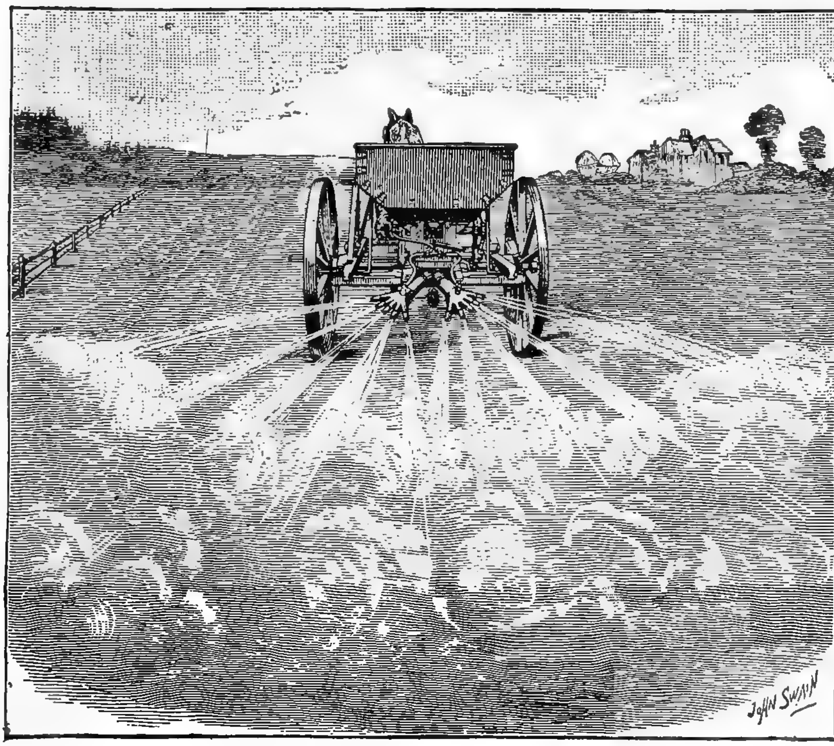


FIG. 91.—The Strawsonizer distributing a liquid.

which the material is blown in a fan-like form covering a width of about 23 feet. Liquid or pasty insecticides are distributed through suitable nozzles fitted in place of the dry distributor and arranged for either vertical spraying for hop vines or trees, or broadcast spraying. To do efficient work the machine must be drawn at a brisk pace, and as the draft is not heavy this may be accomplished by a single horse. Water or liquid insecticides are thrown out in a mist-like spray and powders are distributed with great uniformity.

In the case of finely-slaked lime every leaf is coated as with hoar frost.

The machine was originally designed to combat insects, but it has proved valuable in many other ways. As a broadcast sower of seeds its distribution is very uniform over a width of 18 feet, and by its use it is possible to sow 30 or 40 acres per day. As a distributor of fertilizers it promises to supplant many of the older machines. Outside of agriculture it may be employed to scatter sand on slippery streets or to distribute disinfectants or deodorizers in plague-infested towns or noisome places.

This machine (Fig. 91 and Pl. XV) was tested in August, 1889, in the Exposition grounds in the presence of M. Tisserand, Director of Agriculture, and a special jury and was awarded a gold medal.

The "Strawsonizer" is constructed in four sizes ranging in price from £12 to £30. The two smaller sizes are for hand work.

STRATTON'S TREE-PLANTER.

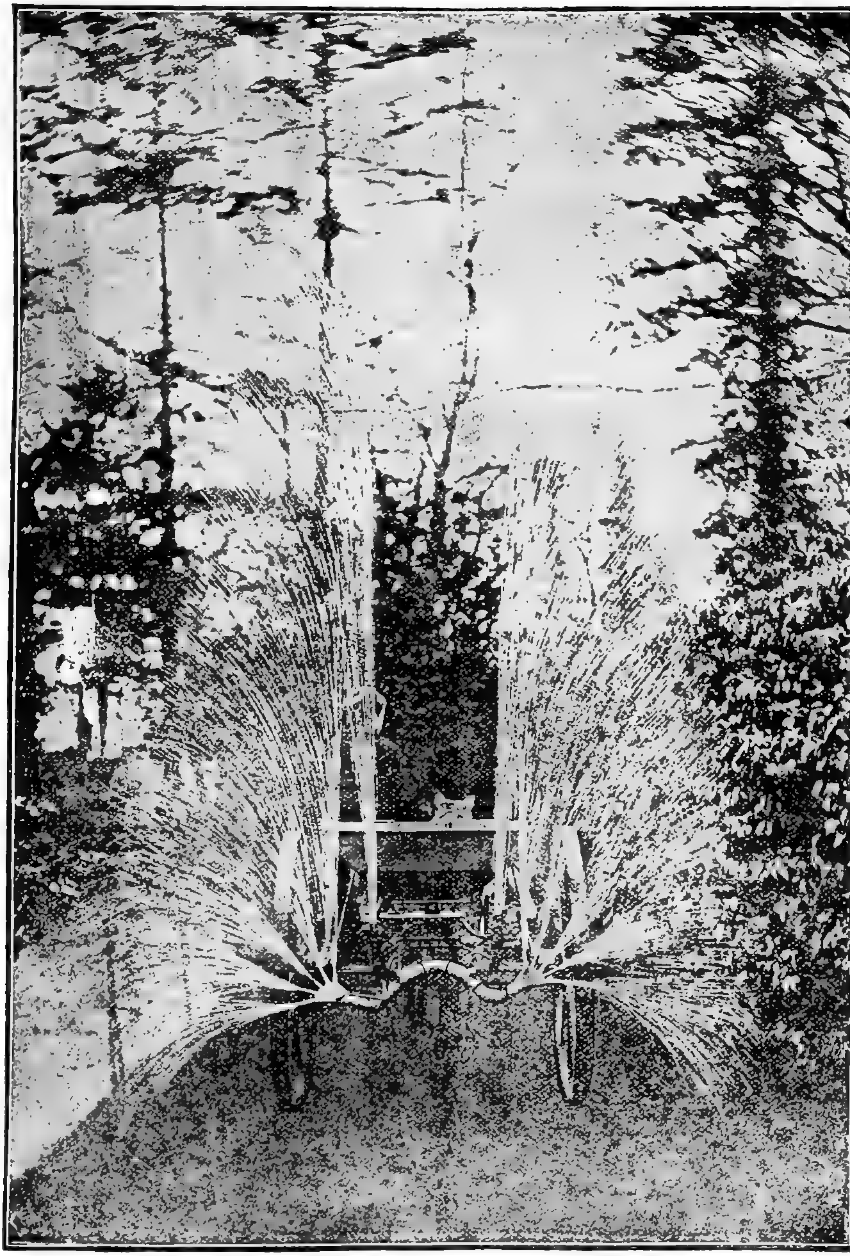
The invention of the tree-planting machine, to which reference was made in the Introduction, is, perhaps, the most important advance recently made in forest-planting; and in our Western prairie States, where the lack of forests is most strongly felt, this implement promises to be of especial service. The machine is very simple in construction and has been tested for two years, giving excellent results. A medal was awarded it at the Exposition. (See Plates LXIII, LXIV, and LXV.)

The inventor, Mr. Thomas A. Stratton, a farmer near Lincoln, Nebraska, planted with this machine in 1886, with the aid of one man, 100,000 two and three year old seedling trees in 8 days, in ground mostly unprepared. On April 22, Arbor Day, Mr. Stratton set 15,200 trees unaided, of which 95 per cent were alive and growing in October of the same year and were in 1888 in a thrifty condition. As improved the machine is estimated to be able to prepare the ground and plant in a thorough manner from 20,000 to 30,000 trees per day.

Prof. B. E. Fernow has described the working of the machine in his report to the Department of Agriculture for 1888 (Rep. U. S. Dept. Agr., 1888, p. 688), and has a further account of it in his report on Forestry in this volume (chapter XXIX).

THE DONDEY PEA-SHELLER.

The following figure (Fig. 92) represents one of the few novelties at the Paris Exposition in the line of agricultural implements. It is called *l'Ecosseuse,* and is a machine for shelling green peas, beans, etc. The apparatus consists of a hopper which automatically distributes the peas to be shelled onto a friction plate between two sets of conical



SPRAYING HOP VINES WITH THE STRAWSONIZER.

fingers, the centrifugal action of which accomplishes the shelling almost instantaneously. The pods and peas are thrown against a felt protector, rebound away from the fingers of the sheller and are carried into an interior cylinder. In this cylinder an axis or screw with paddles agitates the pods and discharges them at the rear, while the peas pass through perforations in the cylinder. The second cylinder retains and conducts the large peas; the small ones which pass through the perforations escape at the extremity of the exterior cylinder. The bits of pods, etc., carried away with the peas fall through the elongate perforations in the exterior cylinder. The triple cylinder separator is mounted on movable supports which

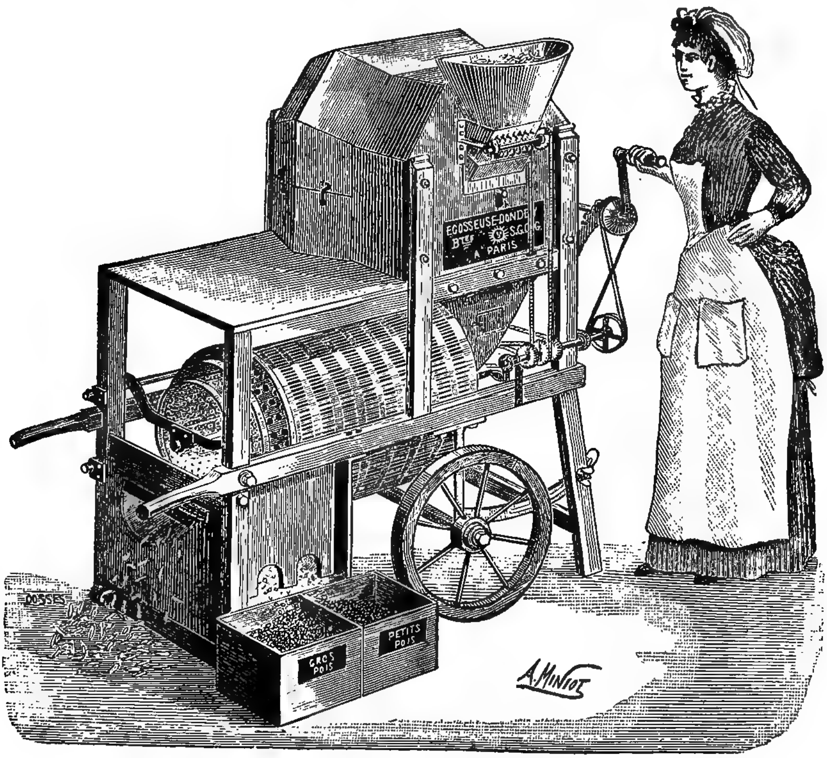


FIG. 92.—L'Ecosseuse or pea-shelling machine. M. Thullier, Paris, France.

vibrate with the action of the machine and prevent the pods and peas from adhering to the perforations.

The peas, large and small, fall on an endless apron the inclination of which directs them to their respective receivers, while the fragments of pods, etc., are discharged on the other side.

The peas are delivered shelled, cleaned, and sorted into two sizes, and, with proper facilities, at the rate of a bushel of pods per minute.

The Ecosseuse is made in three sizes, and is sold at 160, 850, and 2,000 francs.

CHAPTER VI.

CLASS 75.—VINE CULTIVATION AND WINE MAKING.

Models of buildings used in vine cultivation.
Apparatus used in the cultivation of the vine.
Appliances of wine vaults, cellars, and vats. Presses.
Processes and methods employed in fighting diseases of the vine.
Collection of vines.

PART I.—REVIEW OF THE EXHIBIT.

By C. V. RILEY.

FRANCE.

The French exhibit in Class 75 was installed upon the Quai d'Orsay, near the Pavillon de Dégustation, and was quite extensive, there being no less than one hundred and fifty-seven exhibitors. It exceeded the exhibits of all other countries together and was ornamented with scenes of vineyards, wineries, trellises, the paraphernalia of wine-making, and the implements of the vineyard. Plans and drawings of special domains were shown. The Château d'Issau, belonging to M. Roy, president of this class, was represented by a remarkable relief model. M. Roy has successfully defended his vines against the Phylloxera by the use of bisulphide of carbon and sulphocarbonate of potassium; while an experimental field of secondary French stocks has been saved by submersion. Near this model was a similar representation of the Château Laudenne, which may also be considered a type of the regenerated vineyards of Médoc, a Department in which the vine-growers have been eminently successful in their defense against the Phylloxera. Very useful and instructive viticultural charts of Burgundy, Bordelais, and Champagne were displayed along the walls of the gallery and were accompanied by tables concerning the principal centers of wine production.

Collective Exhibits.—The various exhibits which have just been mentioned formed in a manner the complement of some very remarkable exhibits made by the principal agricultural societies and clubs (*comices*) of those districts in which the vine is the principal culture, such as the Departments of Gard, Hérault, Aude, Pyrénées-Orientales, Gironde, Rhône, etc. These collective exhibits were composed of the following: Plans, descriptions of domains, and, in some cases,

of vines and wines, with methods in use at present in reconstruction. Here also was collected together a host of information which testifies to the unremitting efforts made for the improvement of French viticulture.

The Société Centrale de l'Agriculture de l'Hérault exhibited a chart which, by means of concentric circles of various colors, indicated in a striking manner the progress attained in the way of reconstitution in that region, which has so cruelly suffered from the Phylloxera. In 1880 there were in Hérault only 2,500 hectares of American plantation, while in 1885 there were 45,000 and in 1888 there were 93,000 hectares. Last year, 1888, the wine harvest in the Department of Hérault attained the respectable figure of 4,507,800 hectoliters. In support of this improvement, a large number of samples of wine were shown in an elegant *kiosque*, with an assortment of extremely interesting plans of important domains of the district, such as the great viticultural establishments created on the sands of the southern coast by the Compagnie des Salines du Midi, and the Domaine de Guillemain, redeemed with resistant vines (180 hectares), from which the proprietor, Comte d'Espory, harvested in 1888 more than 12,000 hectoliters. Notable also in the exhibit of Hérault were the results obtained by the viticulturists of the commune of Clapiers, who commenced their American plantations nearly fifteen years ago.

According to statistics, the Department of the Gard produced in 1888, 1,465,310 hectoliters of wine; in 1880 its production had sunk to 293,068 hectoliters.

In the exhibits of the Société de l'Agriculture de la Gironde, and in those of the Comices of Libourne and of Cadillac, it was shown that the harvest of 1888 in the Bordelais district amounted to over 3,000,000 hectoliters. The ancient vineyards of the Bordelais are again reëstablished and there are nearly 150,000 hectares under cultivation; the few gaps caused by the Phylloxera are almost all refilled.

Too much can not be said of the tenacity with which the wine-growers of Bordelais have combatted the various parasites which attack their vines, and by means of which they have preserved the precious heritage of their ancestors from destruction. It was in this region also that the *bouillie bordelaise*, that excellent remedy against most of the fungus diseases of the vine, was first applied.

The Departments of the Aude and the Pyrénées-Orientales also figured at the Exposition. Aude possesses 96,475 hectares of vines, and produced, in 1888, 1,122,000 hectoliters of wine. The Société Centrale de l'Agriculture de l'Aude made a very original exhibit of its samples of wines, constructing with the bottles a model of an edifice representing the Porte Narbonnaise of the old city of Carcassonne.

Implements for Vine-culture.—As to the implements, properly so called, for vine-culture, plows, cultivators, hoes, harrows, rollers, etc.,

there was nothing very extraordinary in the French exhibit to record except that in the construction of such instruments various improvements in minor details have been made since 1878. In the main the exhibit was poor—but two or three manufacturers having sent specimens of their work. The manufacture of this class of implements is distributed over a large area of the country and is in the hands of a host of small local factories which made no exhibit. The firm of Souchu-Pinet, of Langeais (Indre-et-Loire), was almost the only one exhibiting, and their tools have a well-merited reputation.

Presses, Materials for Vats, Cellars, etc.—If the Exposition was poor in vineyard tools, this was not the case as regards tools for wine-making and wine-preserving, for many manufacturers responded to the call and exhibited their goods, consisting of presses, pumps, vats, tuns, experimental vats, barrels, etc. At the entrance to the gallery specially devoted to such instruments was erected a formidable barrier of immense tuns, one of which had a capacity of 6,000 liters and was made by a firm at Nancy. On either side were exhibits of the celebrated manufacturers Noël, of Paris, and Mabille Brothers, of Amboise, the former noted for their water or wine pumps, the latter for their wine presses. Not far from these a *chai modèle* was constructed, a certain number of specialists having united to present a typical plant of wine-making machinery such as is ordinarily in use. The wine, received in casks, is put directly into a cistern made of cement, whence a pump operated by a gas motor conveys it into an upper distributing reservoir of strong sheet iron lined with porcelain tiles. The wine then flows from the reservoir downward to a filter or to a Pasteurising apparatus, and is then again collected in casks. Such instructive model plants are worthy of imitation by dealers desirous of having well-prepared wines which are to be exposed for sale.

Processes and Methods employed to combat Maladies of the Vine.—As might have been expected, the portion of the exhibit devoted to these purposes was most complete. As far as the Phylloxera is concerned, the *pal-Gastine*, so often described and exhibited by the Société de l'Avenir Viticole of Marseilles, still maintains its superiority for the distribution of bisulphide of carbon. Of an entirely different conception were the mechanisms constructed by the Fafeur Brothers, of Carcassonne, and by M. Thirion, of Paris, for the distribution of bisulphide of carbon mixed with water. These machines have for several years been in use in the Médoc district and in the Department of Aude, in conjunction with the use of sulphocarbonate of potassium, for which steam pumps are also used. A large number of centrifugal pumps, to be worked by movable steam engines, show great adaptability for use in submersion, and were seen at work on the borders of the Seine.

Spraying Apparatus, etc.—A special competition of spraying noz-

zles, etc., for the application of copper-salt remedies, etc., against mildew and black rot (such as the *bouillie Bordelaise*, ammoniacal copper solution (*eau-celeste*), solution of sulphate of copper or blue vitriol, etc.), was held in July under the auspices of the Exposition, at Mareil-Marly, near Paris, and is treated of in the previous chapter.

Grafting Tools.—Although the grafting of native stock upon American vines is practiced upon a very large scale in France, yet of all instruments or tools which have been invented for these purposes, there were very few shown in the French exhibit. Viticulturists generally recognize the fact that manual skill is the best here, and that a good knife in the hands of a skilled operator is often preferable to the most perfect instrument.

Collection of Vines, etc.—The collections of vine-stocks, grafts, etc., shown under the trees on the Quai d'Orsay, were insignificant and were in direct contrast with the very interesting vine exhibit made by the United States which attracted very general attention on account of the importance of American stocks in the regeneration of French vineyards. The subject of American stocks is treated further on under the topic of Cultivation of the Vine. The numerous samples of wines, almost all sent by proprietors from districts formerly famous and now reconstructed, attested the vitality of French viticulture. Many important samples of wines derived from American vines, were sent from the Gard and from the Hérault, and these are highly appreciated in commerce. Wine from the Jacquez vine predominates, since such wine has important qualities which cause its immediate acceptation by large dealers. The Jacquez, the Herbemont, and the Red Othello are the only American vines with red fruit which have been adopted for extensive culture. Among white grapes there are only the Noah and the white Othello which are deemed capable of producing good wines. But since wines produced directly from the best American vines are of inferior quality, compared with the better French wines, French grape-growers have preferred the custom of grafting their native vines on American stocks. A great many excellent samples of wines made from grapes from grafted vines were shown at the Exposition, absolutely demonstrating that grafting has no influence upon the quality of the wine.

ALGERIA.

The exhibit made by the French colony Algeria was next to that of France in amount and was the only other exhibit of any considerable importance in this class.

The official catalogue gives a list of thirty-seven exhibitors; many of these exhibits, however, could not be found, and the entire Algerian exhibit comprised very little that was new, important, or interesting. There were several exhibits of plows of good ordinary pattern, but which did not present any new features.

There were a number of collections of casks of various forms and sizes, also of vine-stocks raised from seed, and two well-made models of vineyards with wine cellars, outhouses, etc.

I was informed that American stocks were not much used in Algeria, there being but little need for them, as the Phylloxera is almost unknown there. The absence of the Phylloxera was explained by the statement that "few plants are introduced into that country and so no Phylloxera is brought with them." The fact unfortunately is that the Phylloxera has gained a strong foothold in Algeria.

One exhibit which was said to be essentially Algerian, made by Paul Pellizzari, Birtouta (Alger), may be noted. It consisted of bricks of peculiar form adapted for building large vats for the best wines; the inside surface of each brick is coated with a tar composition, of which no full description could be obtained.

The viticultural exhibits of other countries was very meager and may be disposed of briefly.

AUSTRIA-HUNGARY.

The exhibit consisted of an unimportant collection of cellar ware, corkscrews, bottle stoppers, brushes, small siphons, etc., and was made by Mr. J. Peterka, of Vienna.

BELGIUM.

Belgium made no exhibit in Class 75, but in a short notice on viticulture in the Belgian catalogue, this industry is shown to be in decadence as regards vines grown in the open air, though there is considerable cultivation of vines under glass.

A valuable manuscript paper, by Joseph Moreau, on the destruction of the Phylloxera and the improvement of viticulture was submitted and mentioned in the French catalogue, but was afterwards withdrawn by the author.

BRAZIL.

Brazil, though mentioned in the French catalogue, made no exhibit whatever in this class.

ITALY.

A noteworthy feature of Italy's exhibit was an immense tun, holding 80,000 liters and very well constructed from oak coming from Trieste, Austria. A number of good presses were shown by E. Meschini, of Gallarate.

A. Notari & Co., of Bologna, made a small showing, consisting of a number of hand bellows for applying pyrethrum and other powders, and a knapsack pump provided with a nozzle of the Riley type.

LUXEMBURG.

A small exhibit of machinery consisting of wine presses and various implements employed in the manufacture of wine and cider, was made, but contained nothing new or worthy of particular notice.

SWITZERLAND.

The Switzerland exhibit was trivial, consisting of a few grape seeds without description, and a small wine press.

No countries except those above mentioned made any exhibit in viticulture. It is surprising that Spain, which had a very large show of wines, showed nothing of its viticulture. The same may be said of Brazil; and it is curious that the viticultural exhibits of Austria, Italy, and Switzerland were not more important, these all being great wine-growing countries and having made good exhibits of wines. Monaco and Chile also showed wines. Roumania had a good show of wines, and, though making no show in Class 75, it issued a pamphlet upon viticulture. There was a special building on the Trocadéro devoted to Australian wines, and a special "Journal of the Board of Viticulture" of Victoria, Australia; yet no show in Class 75. A considerable additional number of small unimportant wine exhibits were also made.

PART II.—CULTIVATION OF THE VINE.

SOIL.

It is a general truth that the vine is adapted to and may be grown successfully in a great variety of soils. This is shown by its occurrence in the wild state in all parts of the world and in soils of widely different composition. The adaptability of rocky or hilly land to viticulture, especially where southern or eastern exposure may be obtained, is universally recognized, and the vine-clad hills of France, Italy, Switzerland, etc., attest the truth of this in their products of unexcelled grapes.

The soils on which vineyards are grown in France may be described as follows:

Alluvial Soils.—The alluvial soils comprise the river valleys, or bottoms and drained marshes, etc., and consist of vegetable mold and sand with a subsoil of clay sand and marl. The land known as Palus, comprises marshes fitted for culture by drainage and may be classed with the alluvial formations. The grape grows successfully in soils of this character, but the wine, while possessing color and vinosity, lacks delicacy of flavor.

Argillaceous Soils.—The clayey or argillaceous soils which usually overlie stony subsoils, occur commonly on high and hilly districts,

and if they contain sufficient iron, are well adapted to vine culture. Manuring and the addition of light earth (sand) are frequently employed to improve these soils.

Marly or calcareous Soils.—Soil of this nature occupies a considerable proportion of the country and is well suited to the vine. The soil known as gravelly or sandy-gravelly is of similar composition, and on it are established many of the more famous vineyards.

Silicious Soils.—Much of French vine-growing is on soils of a silicious nature mixed with clayey calcareous elements.

Bâtardès.—The land intermediate between the high rich land and the silicious or sandy land termed in some districts *bâtardes* or *terres bâtardes* varies greatly in fertility and is commonly devoted to the growth of white grapes.

Sands.—Planting vines in almost if not quite pure sand, was early adopted as a means of preventing the Phylloxera attacks. It is practiced in the Mediterranean region, or wherever the sand occurs and present no especial difficulties. It is described more at length in the discussion of the means employed against the Phylloxera, in Class 76.

The Subsoil.—The nature of the subsoil has an important bearing on successful viticulture. A compact subsoil impervious to moisture is very objectionable, while a sandy, gravelly, or stony subsoil allows a free passage to superfluous moisture and is especially favorable to vine-growing. Subsoils of the latter class are of advantage also by affording strong foothold for the roots, and by allowing them to penetrate to depths where the temperature is comparatively uniform. The former subsoils may be and are greatly improved by being thoroughly dug up and disintegrated. Thus calcareous or marly subsoils are often compact, but when dug up and mixed with the upper layers of earth, very favorable results are obtained especially in the growth of white grapes. Many of the best vineyards of France are on grounds worked over in this manner.

Preparation of the Soil.—Vine-growing in France is largely in the hands of small holders, and the preparation of the land for planting and also after cultivation is largely accomplished by hand labor, employing the spade and pick after methods in use for hundreds of years. Hand labor is necessarily expensive, and the increase of wages in France is leading more and more to the substitution of machine work.

In the breaking up of impervious subsoils and mixing them with the superficial layers of earth, and also in the plowing up of old vineyards for replanting, gigantic plows are employed—plows much larger than any commonly used in this country.

One of the latest models of the implements of this class is shown at Fig. 93. It is manufactured by P. Fondeur, of Viry, France, is entirely of Swedish iron, and is designed especially for preparing

land for vines or for the digging up of old vineyards for replanting. An ingeniously contrived apparatus permits the operator, seated at the rear, to regulate the plow while it is in motion.

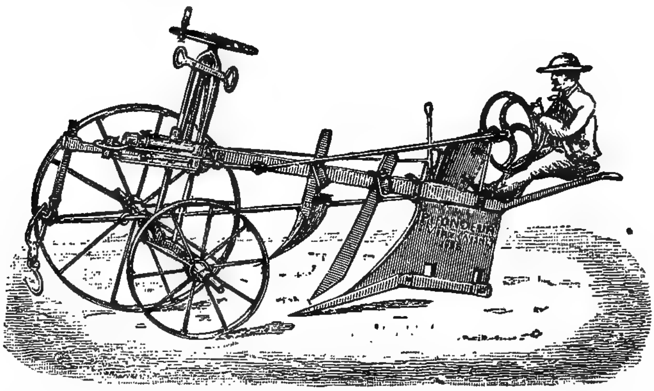


FIG. 93.—Vineyard plow. P. Fondeur, Viry, France.

For lighter soils, simple or double plows are used, or gang-plows with two to five shares. The double or turning moldboard plows are much more commonly used in France than in this country, not only in vineyard work but in the preparation of the soil for all crops. Great improvements have been made in the construction of plows in France in the last decade; the heavy wooden beams and cast-iron parts have been replaced with steel and wrought iron, and great gain has resulted in lightness of draft together with increased durability.

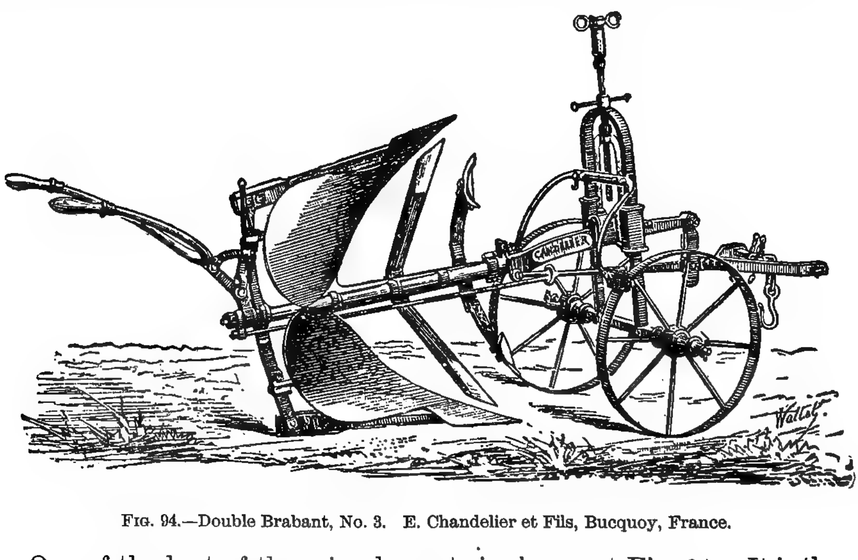


FIG. 94.—Double Brabant, No. 3. E. Chandelier et Fils, Bucquoy, France.

One of the best of these implements is shown at Fig. 94. It is the Double Brabant of E. Chandelier et Fils, Bucquoy, France, and is

constructed entirely of steel. The draft rod is attached, as is shown in the figure, about the middle of the beam and back of the fore carriage (*avant-train*) in order to bring the force as near as possible to the resistance. These plows, of which some twelve sizes are manufactured, range in weight from 100 to 380 kilos. and in price from 145 to 500 francs.

In this country the double moldboard, or *hillside* plow as it is generally termed, is comparatively little used except, as its name implies, in hillside work when the land is so steep that the furrow can only be turned down hill. In France, these plows are very commonly used, and are made in sizes from 1 horse to 16 horses, or oxen, which are more frequently employed.

The gang-plows are used in light soils, and also as cultivators in vineyards.

In the preparation of the land, considerable attention is given to drainage, which, as it does not present novel features, need not be discussed here.

Manuring is considered to be always essential, and in all viticultural works the discussion of fertilizers and manures forms an important topic. Heretofore, not enough attention has been paid to this subject, but the necessity of artificially enriching the land or supplying lacking elements has now come to be generally recognized, and the results fully repay the expense entailed.

Fertilizers are now applied to all kinds of soils, including even the rich alluvial bottoms.

METHODS OF PLANTING.

The methods of planting followed in France are various, each district having methods more or less peculiar to itself or adapted to the particular conditions obtaining in the locality. It will be impossible to describe these in detail, but a few of the more generally employed methods may be profitably outlined.

Trenching.—A common but somewhat costly method and one of the best is called planting by reversion, or trenching. Vines planted after this system produce early and abundantly, but are consequently short-lived. Trenches are opened in the direction of the vine rows, the earth from the last made being filled into the preceding trench. Manure is thrown in and the vines are then planted and supported by stakes.

Planting with Bar.—A method of planting also in general use is to thoroughly break up the subsoil and manure, if the soil demands such treatment, and then plant in holes made at the proper distance with a bar or rod of iron. In light soils, free from rocks and having porous subsoils, working of the superficial layers is all that is required. The hole is usually made of sufficient size to admit of the use of manure about the plant.

Planting in Furrows.—Planting in furrows thrown out with a plow is one of the most economical methods, but is little employed, and only in deep soils. A deep furrow is made and filled in partly with manure, after which the plants are set and the earth thrown back about them.

Time of Planting.—Planting occurs from the month of February through March and April, and may be continued to the beginning of June. For late planting the vines are kept from growing by being stored, under cover of earth, on northern exposures.

Disposition of the Vines and Pruning.—The methods of planting, pruning, and cultivating the vines are extremely numerous. In the departments of Tarn, Lot, Ardèche, and Puy-de-Dôme the vines are planted in rows; and on the contrary, they are evenly distributed over the ground (*en foule*) elsewhere in the southern central region of France.

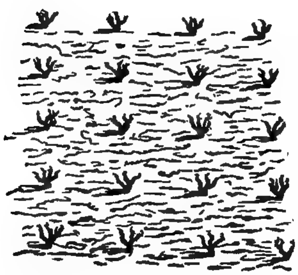


FIG. 95.—Plan of Hérault vineyard. (From Sahut.)

When planted in rows there is no fixed direction for ridges, except to facilitate drainage without loss of soil. Some vineyardists lay their lands from east to west in the belief that only the first few feet of each row will be injured by the prevailing west winds and hail. But this practice is beneficial only in the case of low vines, such as those of Médoc. Others, with the object of getting the greatest amount of sun along the rows, plant from north to south.

The vines are commonly set in double rows with a space between the rows of about 1 meter and an alley space of about 2 meters. Where intermediate culture is practiced, viz, the growth of grain or vegetables between the rows, the method outlined is considerably modified. The vines are then planted from two to four rows together, with an alley of space between the groups of rows of 4 to 8 meters. (See Fig. 98.)

In Hérault the vines are planted about 1.5 meters apart in all directions, the hectare thus accommodating 4,444 stocks, which for an acre would be about 1,777 stocks. The crown of the vine breaks into four arms, each bearing one spur pruned above the second bud. (See Fig. 95.)

In Bourgogne the vines are planted much closer together and differently pruned, the old wood being nearly all cut away down to the trunk and the new canes supported on stakes. (Fig. 96.)

The vineyardists of Vaucluse adopt a plan of pruning very much like that followed in Hérault. It consists in pruning the vine down to three arms, the crown being just above the ground level, with one spur each of two buds. (Fig. 97.)

Provence vineyards are mostly planted *en jouallès*, that is, with cereals, potatoes, or other roots cultivated between the vines. The

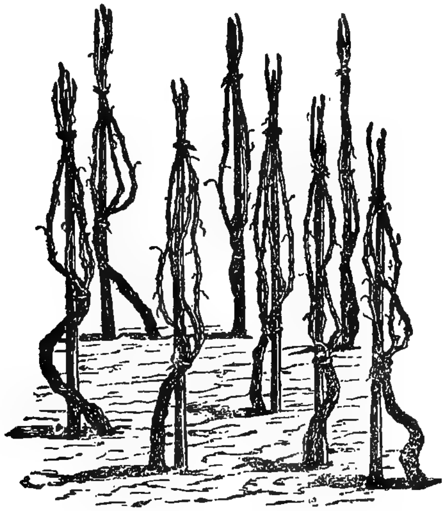


FIG. 96.—Bourgogne vines fixed to stakes. (From Sahut.)

vines are, as a rule, set out in single rows, but sometimes this practice is modified into series of three, four, or five rows, 1 meter (about 3½ feet) being left free between the rows and the secondary cultures. By this plan the vines have each about 7 feet of clear space. (Fig. 98.)

FIG. 97.—Vaucluse vines. (From Sahut.)

On the contrary, in the Pyrénées and Dordogne districts the vines are raised on tall stakes or trees, from which the canes shoot out on all sides and fall again toward the ground. This system has also been followed in Italy.

FIG. 98.—Vineyard planted *en jouallès*. (After Guyot.)

The vineyardists of Maconnais plant in hills, with or without secondary cultures, and also according to the Hérault method. In the department of Ain, Isère, and Savoie the rather unsatisfactory low railing is used, or else arbors and latticework for vines of medium growth.

Great diversity of training and pruning is found in the Gironde district. Fig. 99 shows the mode of training and pruning adopted in the Graves. Two long fruit branches are drawn out on either side and fastened to supports, each branch having one spur of three or four buds, and in pruning particular attention is given to secure strength of the stock.

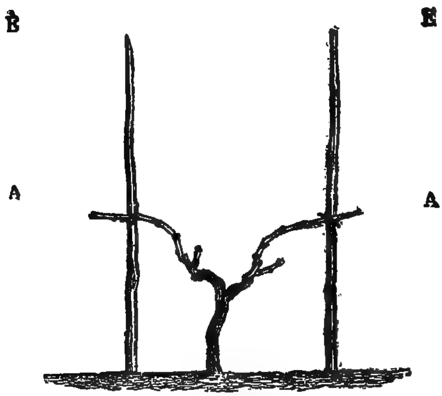


FIG. 99.—Mode of pruning adopted in the Graves. (From Sahut.)

Figure (101) represents the method of supporting the vines employed in Haut-Médoc. The rows are commonly about 3½ feet apart, a hectare including 9,000 vines. The support is a sort of fence or rail, to which the fruit branches are attached. There are many other methods employed in this district, varying according to the soil. In palus lands a rambling vine is supported upon large stakes or when more fully grown trained along lines of wire. In the "cordon" system of pruning, now coming into very general employment, the fruiting branch is

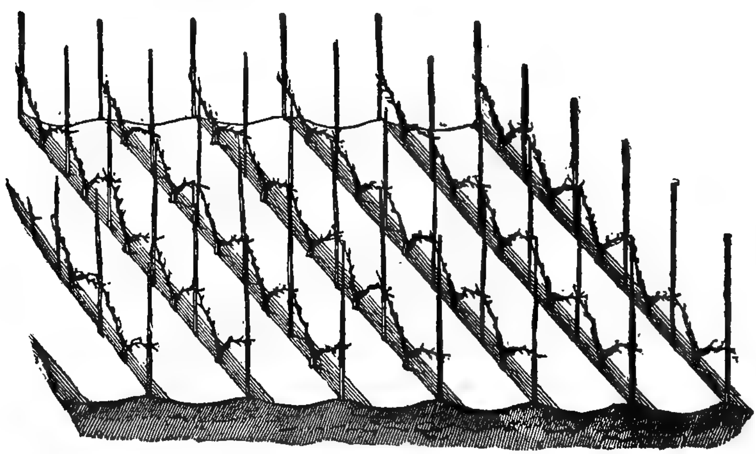


FIG. 100.—Same as Fig. 99, but showing entire vineyard. (From Sahut.)

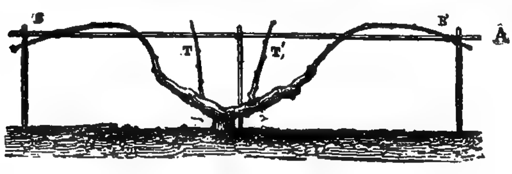


FIG. 101.—Method of training followed in Haut-Médoc. (From Sahut.)

shot out on the one side, and fastened to the support, while on the other side of the crown of the vine a spur is allowed to develop

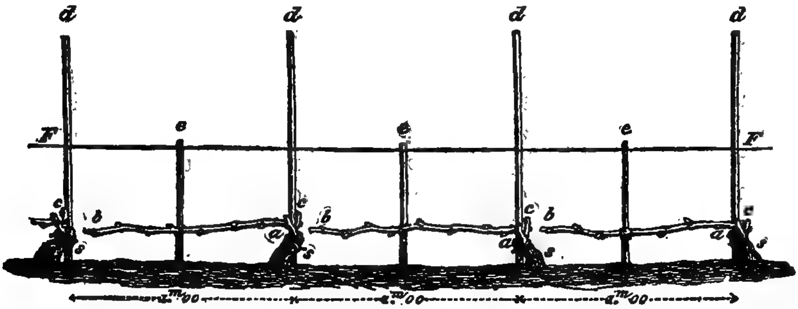


FIG. 102.—The Guyot system. (After Guyot.)

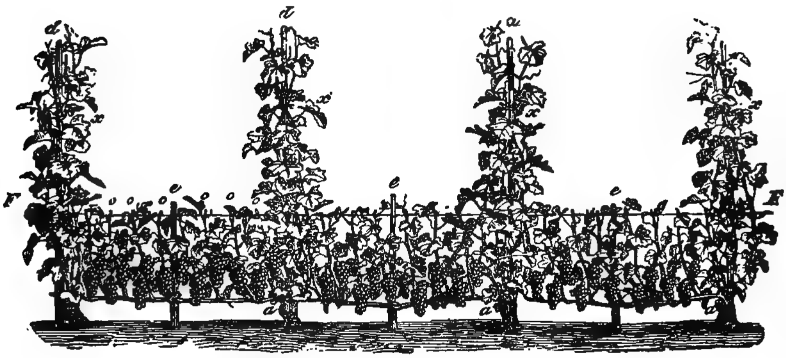


FIG. 103.—The Guyot system fully developed. (After Guyot.)

FIG. 104.—The bush system of training. (From Sahut.)

which is destined to furnish the fruiting canes of the ensuing year. These canes are trained up the long stake at the stump of the vine.

In Beaujolais the stool or bush form (Fig. 104) is considerably employed and with very satisfactory results.

The Marcon "cordon" as shown in Figs. 105 and 106 is slightly different from the Guyot system, represented by Figs. 102 and 103. Dr. Guyot holds this new system in high esteem, and some very remarkable specimens of its fructification were exhibited at the viticultural exposition of Bordeaux, held in 1886. At a time of general unfruitfulness the large yield given by a few experimental stocks trained on this system was particularly gratifying. For success in this process a multiplicity of details demand attention, and on this account it is not likely to become widely adopted.

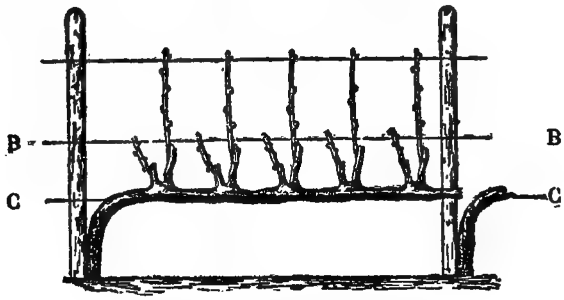


FIG. 105.—The Marcon system of training. (From Sahut.)

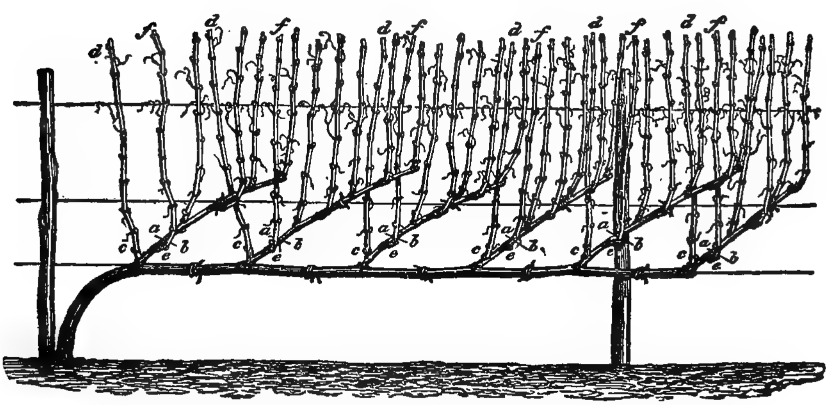


FIG. 106.—The Marcon system of training fully developed. (From Sahut.)

The next cut (Fig. 107) exemplifies the chain method, which is especially adapted to certain localities, such as Chissay, Loir-et-Cher, where it was originally practiced. The arms of the vine, usually three or four, are allowed to grow until they are about 18 or 20 feet long, and are supported at intervals on pegs. Thorough cultivation is hindered by this system, and the amount of manual labor essential to it will undoubtedly prevent its extensive adoption.

Dead trees (Fig. 108) are put to good use in the training of the vine, but here, too, economy in labor is not considered.

The development of the vine from the cutting requires about four years, and the method of pruning for each year does not differ materially from that practiced in this country, except in the case of some of the novel forms of training the vine described above.

The operation of pruning commences after the fall of the leaf and lasts till the heavy frosts, this season being chosen under the impression that if done earlier there would be loss of sap and if left till later the wound would not heal and there would be a loss of sap in the spring.

The pruning is done either with a knife (Fig. 109) or a pruning shears similar to those in use in this country, the latter being much

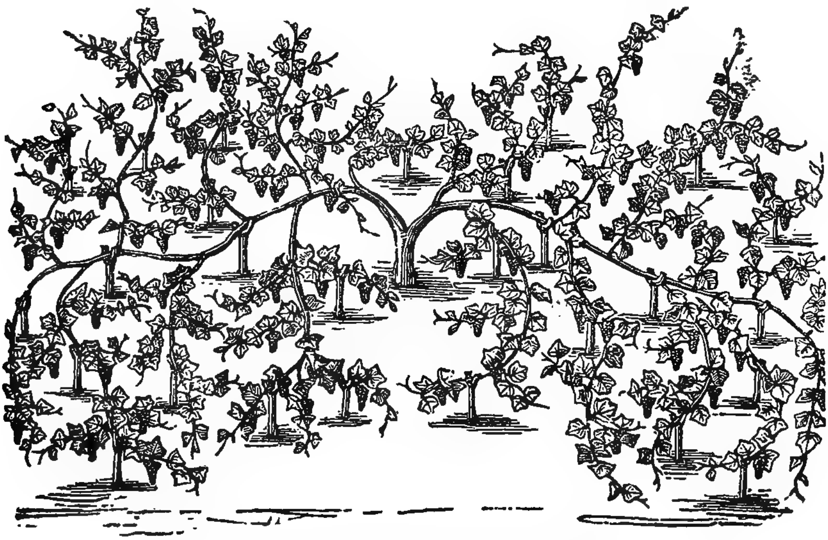


FIG. 107.—The chain system. (From Sahut.)

the most expeditious instrument. In Médoc and many other districts the knife is preferred as making a smoother cut. In pruning young vines the shears are commonly preferred.

The first year the vine is cut back to two buds; the second year the same process is repeated; the third year two short arms are left, and the fourth year sufficient size and strength is attained to give the vine its ultimate shape, the number and disposition of the branches allowed to remain varying with the system of training adopted.

Very generally in France short or close pruning is followed; still the fashion in one Department differs from that in force in the next, and even among the districts of the same Department much diversity exists. Thus in Beaujolais three short arms are left and in the Rhone vineyards the fruit branch is long and arched.

The different methods of training and pruning the grape have special fitness for the localities where they are practiced. The same methods can not as a rule be used universally; yet there can hardly be any doubt but that some modification of the systems of severe pruning in vogue will be productive of good. The climbing and rambling nature of the vine is lost sight of in all or nearly all exist-

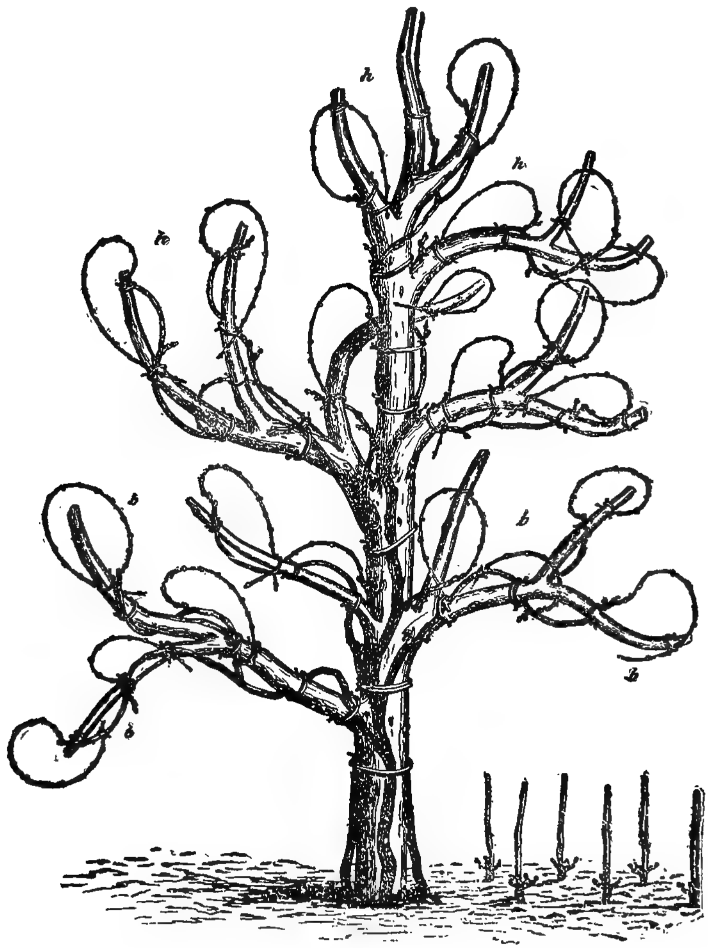


FIG. 108.—Dead tree as vine support. (After Guyot.)

ing modes of pruning it, and though the fruit thus produced may possess superior characters owing to the forcing of all the energies of the vine to the business of fructification, yet from a natural standpoint the vitality of the vine must be weakened and its length of life compromised. It can not be gainsaid, however, that the severe pruning seems to be in accord with the climatic and economic conditions of France and to give astonishing results at gathering time,

but, to repeat, there is every reason to believe that the present degeneration of the grape is in great degree due to unnatural cultivation. It is in response to supposed necessity that the vine in Hérault is cut down to four or five arms, bearing one or two spurs, pruned above the second bud, and the vintages of Hérault have been prodigious until a recent era. A strong stock, many authorities claim, can resist its enemies, and strengthening of the vine by less debilitating pruning may result in great benefit.

Green or summer pruning is practiced in France and is similar to our method of pruning or pinching back.

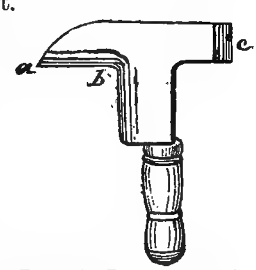


FIG. 109.—Provence pruning knife. *a*, *b*, and *c*, cutting edges. (From Foëx.)

In June the fruit branches are pinched back and shoots and sprouts from the old wood cut away. In July a second thinning out takes place to expose the grapes to better circulation of air, and in August the leaves are often thinned out to facilitate ripening of the fruit. Care is necessary in this last operation to prevent the fruit being exposed to and burned by the sun.

CULTIVATION.

In the cultivation of vineyards old fashioned methods of hand labor are still largely employed, although the use of plows and cultivators is becoming more and more common. The hand implement used is a kind of pronged hoe, by means of which the soil is drawn alternately from and towards the vine. The plow is adapted to the same work, being used more as a cultivator than as a plow, in the sense in which these terms are employed in the United States.

Plowing (if the plow is used rather than the pronged hoe) is practiced four times annually. The first plowing takes place about the 1st of March and is to unearth the vine or rather to throw the earth away from the vine to the center of the space between the rows, the strip of earth between the vines being thrown into the middle of the row by women. The second plowing takes place in April, and is just the reverse of the first, the earth being turned back to the vine. With young vines a woman accompanies the plow and protects each vine by placing her shovel between it and the overturning furrow. A third plowing identical with the first is made in May, before flowering, and a fourth, identical with the second, about the end of June. Further cultivation is generally limited to hand work.

A great variety of plows is employed in cultivation, including simple plows, double moldboard, and gang glows. The simple vineyard plows are frequently capable of being adjusted to unearth or throw the soil both from the vines (*déchaussement*) or to hill up the vines (*réchaussement*). Figs. 110 and 111 represent a plow of this

character, showing its position in the two operations. In these illustrations the rows of circles represent the vines.

The double moldboard plow (*buttoir*), seldom seen in this country

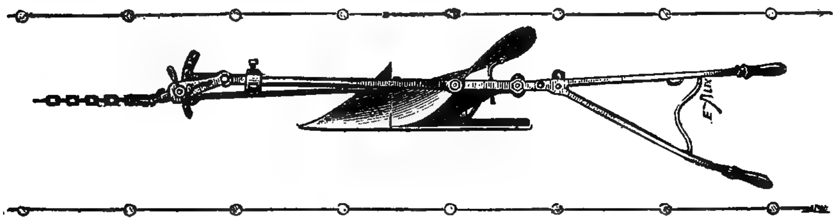


FIG. 110. –Plow disposed for rechaussement. Souchu-Pinet, Langlais Fr.

except in the planting of special crops, as in listing corn, is a very common implement in France and is much used in cultivating the vine, especially where the rows are run close together. With one of

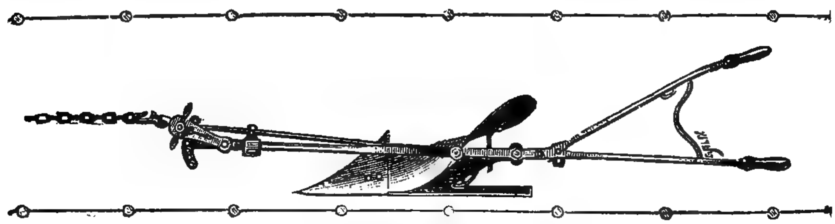


FIG. 111.—Same disposed for dechaussement.

these implements the earth may be thrown up to two rows of vines at once.

Some of these plows are made with expansible moldboards, so that

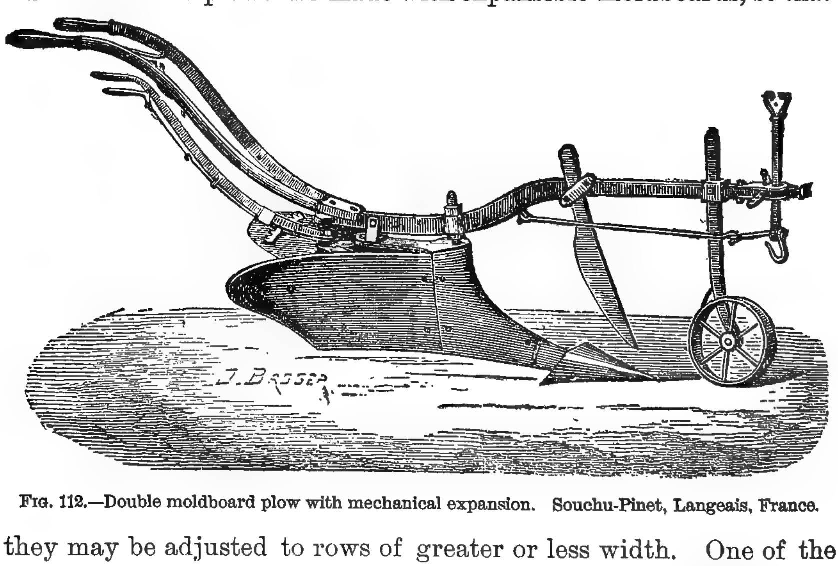


FIG. 112.—Double moldboard plow with mechanical expansion. Souchu-Pinet, Langeais, France.

they may be adjusted to rows of greater or less width. One of the latest styles of these expansible moldboard plows is shown at Fig. 112. The mechanical apparatus for expanding or contracting the mold-

boards is also shown in this and the following figure. The width is modified by moving the lever to the right or left. (Fig. 113.)

The gang plows employed in vineyard work, which, with the styles

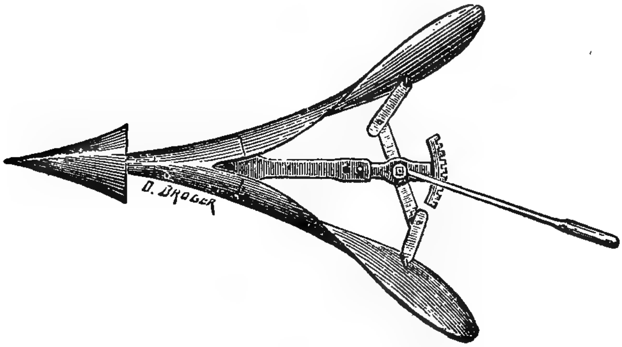


FIG. 113.—Same from above, showing expansion apparatus.

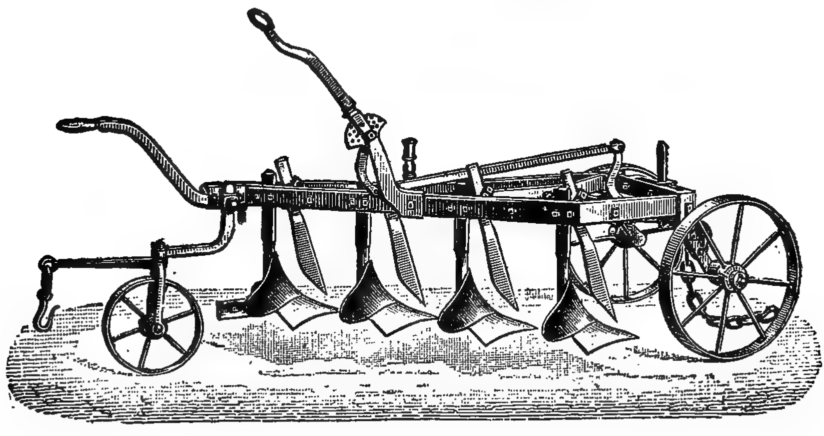


FIG. 114.—Breaking plow for vineyard work. A. Bajac, Liancourt, France.

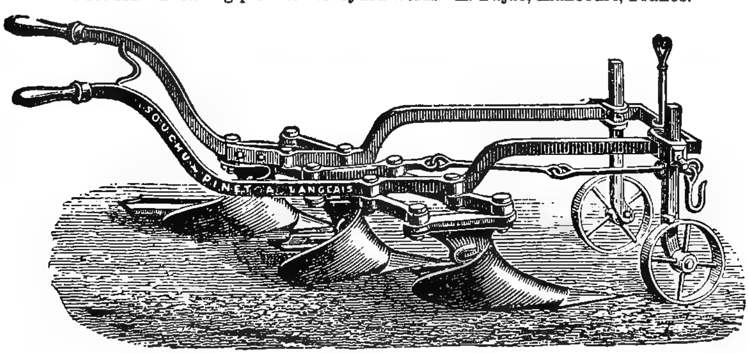


FIG. 115.—Vineyard Plow (*Charrue trisoc.*) Souchu-Pinet.

just figured, largely take the place of cultivators and horse hoes, vary greatly in construction and range in number of plowshares from two to five or more.

A four-plow gang of late pattern is shown at Fig. 114. It is so constructed that it is possible to approach within a few inches of the vines without danger of injuring them.

A three-plow gang capable of adjustment to throw the soil either to or from the vines is also shown in Fig. 115.

The implements figured represent the improved forms, and are much neater in appearance and lighter in weight and draft than the old-fashioned heavy wooden beam and cast-iron moldboard plows (Fig. 116) formerly in use and still commonly met with throughout France.

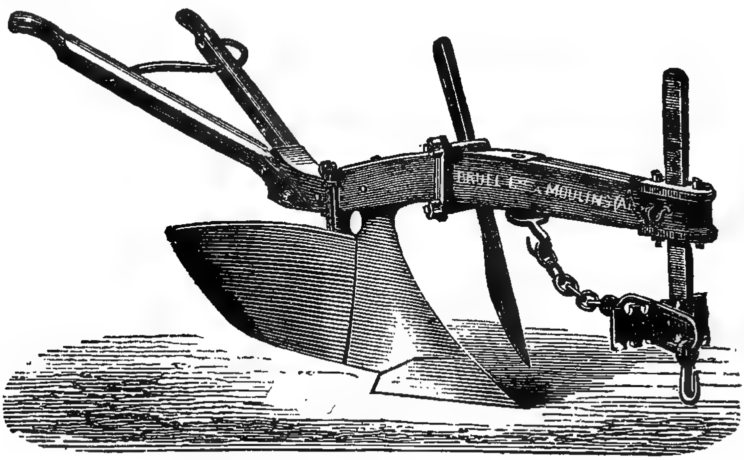


Fig. 116.—French wooden-beam plow.

Horse hoes or cultivators are also used in France, though to a much less extent than in this country. Two forms employed in vineyard work are shown (Figs. 117 and 118).

METHODS OF PROPAGATION.

The multiplication of the vine, as with most other woody plants, may be accomplished by seeds, cuttings, layers, and grafts. The processes involved in the first three methods mentioned are well known and present no particular difficulty and hence need not be discussed here, except in so far as they are a means of furnishing resistant stocks on which weaker but highly prized sorts may be grafted and thus successfully grown.

The well-known fact that French vines of the *vinifera* class may be protected from the ravages of that dread scourge the Phylloxera, by grafting them on resistant American stocks has immeasurably increased and emphasized in France the importance of grafting as a means of propagating the vine, and the extent of the regeneration of French vineyards is incontestible evidence of the effectiveness of this means against Phylloxera.

Space will not be taken to discuss the other uses of grafting, such

as the renewal of old vineyards with more desirable varieties or in the propagation of rare sorts, etc., all of which are important, but which present in the methods in vogue in France no striking features.

The influence of stock on graft or graft on stock is also an interesting subject in this connection, and is usually treated at length by French writers on viticulture. The limits of space prevent its con-

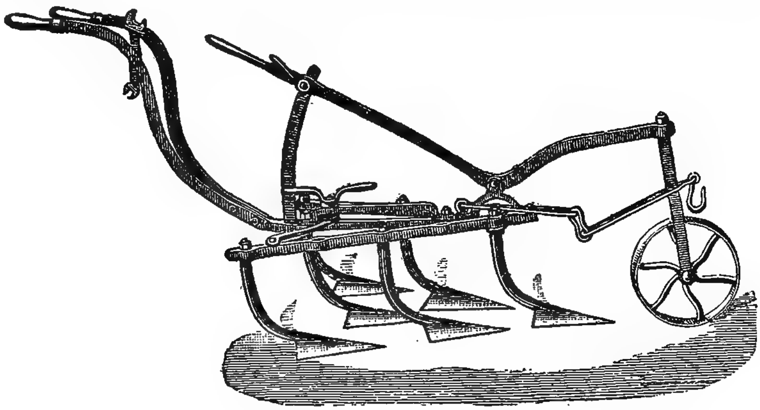


FIG. 117.—French horse hoe.

sideration in this place, but in general it may be said that the effect, particularly of the stock on the graft, is not of serious moment in the practical work of vine-growing and wine-making, as is shown by the extensive testing given it in the reconstruction of thousands of French vineyards.

The effort to produce by hybridization Phylloxera-proof vines has

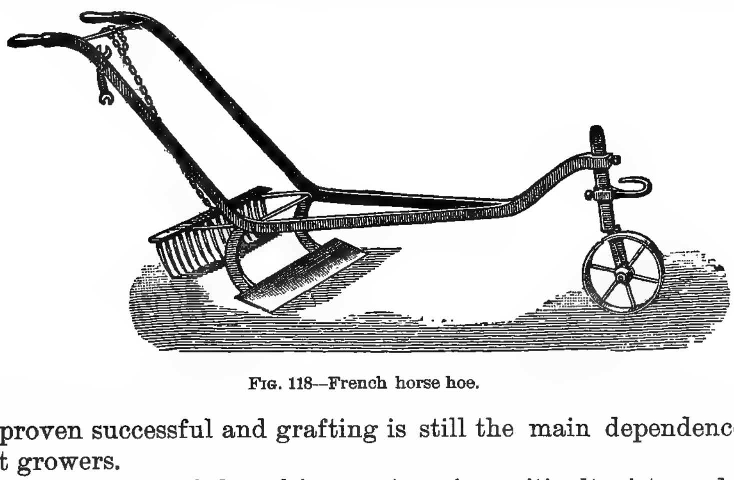


FIG. 118—French horse hoe.

not proven successful and grafting is still the main dependence of most growers.

The importance of the subject to American viticulturists, and particularly in view of the increase of the Phylloxera in the great vine regions of California, renders a detailed account of grafting as practiced in France quite appropriate here. The consideration of the American stocks used follows the subject of grafting.

PRODUCTION OF STOCKS FOR GRAFTING.—Rooted stocks for grafting are obtained from seeds, by layering, and from cuttings, or the graft is made at once on the cutting of a resistant variety in a manner similar to that employed in the ordinary root-grafting of the apple. The third and the last methods are the ones ordinarily employed.

By Seeds.—Seeds are obtained from fully ripened grapes, and experience has shown that they are not at all injured by remaining in the must during the earlier stages of its fermentation.

The seeds are kept during the winter in sand, which towards spring is slightly moistened, and are sown during the month of April. For stocks the plants thus obtained are employed in two ways. They are either grafted directly or cuttings are made from their shoots, which, after being rooted, are used as stocks.

The latter method is preferred, as it gives greater opportunity to select plants which from manner of growth and nature of foliage are best suited for the purpose desired.

By Layers.—The production of stocks by layering is not often followed, other methods being more available and satisfactory; but in the case of certain varieties, cuttings of which do not root readily, it is sometimes practiced. Layering is one of the oldest methods of multiplying vines, and the methods employed are practically uniform the world over. The after-treatment of stocks does not differ from that of those otherwise obtained.

By Cuttings.—This is by far the commonest method in France as elsewhere of multiplying vines or producing stocks for grafting. The celebrated grapes of Europe, derived from *Vitis vinifera*, are especially susceptible to this method of reproduction. Certain American vines present some difficulties, but these have only resulted in a more thorough study of the means to assure success.

The cuttings are obtained, as indicated above, from seedling plants, and also from American vines grown in France. They are also shipped in large quantities from this country—these latter, however, requiring special care by reason of the unavoidable injury in shipping, and are considered to be inferior to those grown in France.

The cuttings are made of various lengths or numbers of buds and with or without old wood attached. The frequent necessity of economizing the American vines leads to the general use of all the shoots from the base to tip.

CHOICE OF GRAFTS AND TIME FOR GRAFTING.—Much more attention than is generally the case should be given to the choice of grafts or scions. Branches that have thoroughly ripened only should be accepted, and they should never be taken from vines that have suffered in previous years from attacks of mildew. The best time to cut them is a little in advance of the flowing of the sap, the later the better, for after this period an excessive evaporation would take place and

result in the drying out and eventual death of the graft, and if it is possible and convenient, much advantage would be derived from cutting them only as needed. When this is found to be out of the question the grafts are bundled together, dampened, packed in straw-covered boxes or bales, and laid away in cool places out of the reach of drying winds. Sometimes the grafts are selected during the progress of pruning, and to preserve them in good condition till they are put to use they are stored away where the air can not reach them, or buried in moist sand. The grafts are often packed in small boxes holding from 25 to 100 at most each, standing them up side by side, so as to admit the sand among the interstices. When this is done in the open air care must be taken to form a sort of penthouse or coop, with earth, over the cuttings, to throw off the rain. Grafting is usually done about the beginning of sap flow in spring, the exact time varying according to the locality, being later as we advance north from the Mediterranean regions. There is no absolute length for the scion, but generally two buds are left upon them; rarely more. The longer the graft the more danger there is that it will be broken off or loosened, either by wind or careless laborers; and, in addition, the probability of desiccation is increased. The important point is to have the graft long enough to securely attach it to the stock. In ordinary grafting the beveling or pointing of the graft ought to start immediately below the under bud and tend a little to one side or the other, so that it may fit close against the wood of the stock and not rest in the middle of the pith. The application of a little gum to the upper cut very successfully checks a superfluous evaporation of sap.

Various Methods of Grafting.—All the methods of grafting employed with woody plants are applicable to the vine, but only a small number give really practical results, and two or three systems only are especially suited to the work with American stocks.

In the grafting of vines, by whatever method employed, it has always been found necessary to protect the graft from the drying of the atmosphere, and the almost universal practice in France to-day in vineyard or nursery work is to unite the scion and stock near or just below the surface of the soil, so that the grafted plant can be banked about with earth and protected until the union has been completely effected.

The methods of grafting by "approach" have been found to result generally in the production of feeble plants, owing to the imperfection of the union obtained. The different methods of cleft and analogous systems of grafting are the only ones of practical importance. The methods in common use are the ordinary cleft or shoulder-graft, full shoulder-graft, the English or whip-graft.

Methods occasionally employed or adapted for special ends are the Pontoise graft, the Champin graft, saddle-graft, heel-graft (*à talon*), the Fermaud graft, cutting or slip-graft.

The ordinary Cleft or Shoulder-graft.—The common shoulder-graft (Fig. 119) is chiefly used in the case of stocks which are too large for whip-grafting. The earth is removed sufficiently to expose

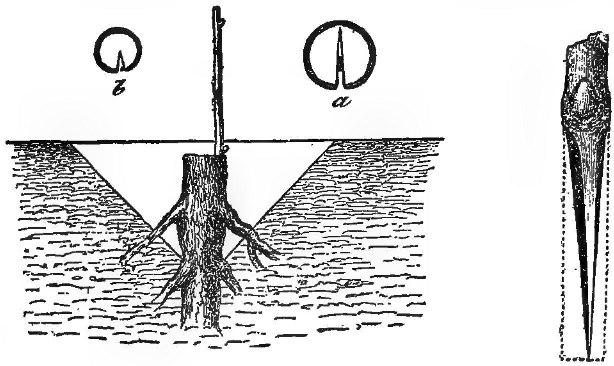


FIG. 119.—Cleft or shoulder-graft. (From Sahut.)

the vine's roots, as shown in the figure, and the stock is cut just below the surface of the soil. A wedge is used to keep the cleft open dur-

FIG. 120.—Full shoulder-graft. (From Sahut.)

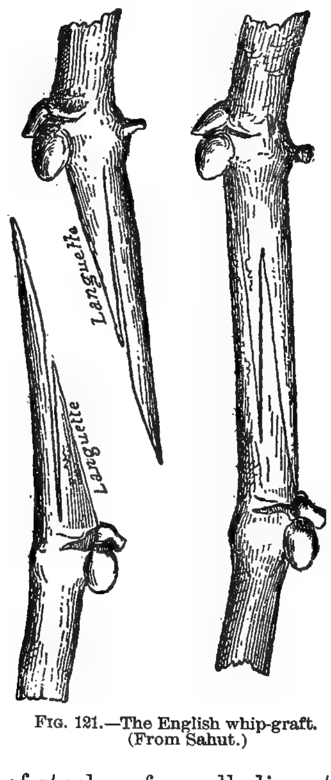


FIG. 121.—The English whip-graft. (From Sahut.)

ing the insertion of the scion. In case of stocks of small diameter the cleft is made with a knife in one side only, or sufficient pressure is obtained by first wrapping the stock.

Full Shoulder-graft.—The full shoulder-graft (Fig. 120) is only used for young plants for which a graft or scion of the same diameter as the stock can be obtained; and on account of the ease with which it is made it ranks next to the whip-graft in popularity, and if carefully made gives fully as good results as the latter graft. There is always danger, however, of splitting the stock too deeply, and the English or whip-graft is therefore generally preferred.

The English Whip-graft.—The application of this graft to the vine in France practically dates from the beginning of the use of American stocks to reconstruct vineyards destroyed by the Phylloxera, and

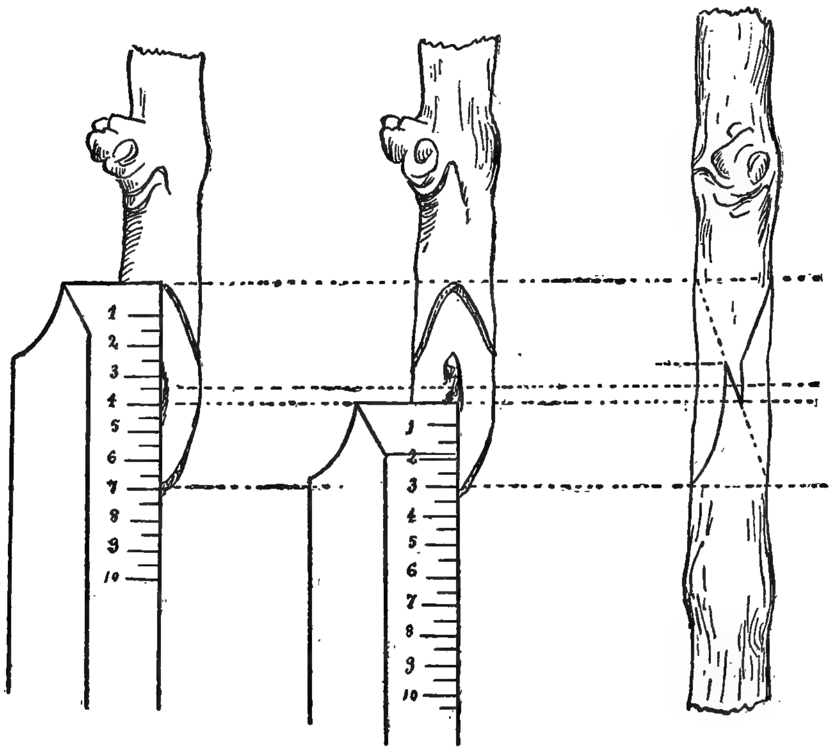


FIG. 122.—The French whip-graft. (From Portes et Ruyssen.)

the best results in this direction are obtained by its use. The ordinary whip-graft is shown in the annexed figure (Fig. 121), but as applied to the vine French vineyardists have found it necessary to modify it slightly. Experience has demonstrated that the long slanting cut and long narrow tongue of the graft as commonly made dries readily, and hence no union takes place; and also that the graft is apt to loosen even with careful handling.

As perfected by French viticulturists the graft is made as follows: Having selected a scion of the same diameter as the stock, the two are cut with a knife by hand or with a machine made for the purpose

at the same inclination or at an angle of 16° to 18°. The cleft should originate at a fixed distance above the center of the oblique cut on the stock or at the same distance below the center on the scion, and should not be more than one-seventh the length of the oblique cut.

It is necessary, in fact, that when the two interior tongues have each penetrated to the bottom of the cleft, the upper and lower extremities of the oblique cut should exactly coincide; and when this is done the two parts of the graft adhere perfectly and strongly without being wrapped.

A slight inconvenience arises from the necessity of selecting stock and graft of the same diameter, which can not well exceed 6 to 7 millimeter, to obtain the best results. This graft is used with American stocks of one year's growth, and in the vigor of the plants obtained and in the large percentage of successful grafts, results far better than any other system, and is justly popular in France.

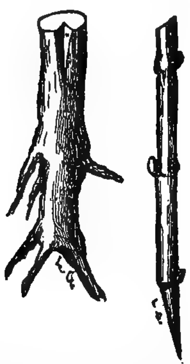


FIG. 123.—Pontois graft. (From Foëx.)

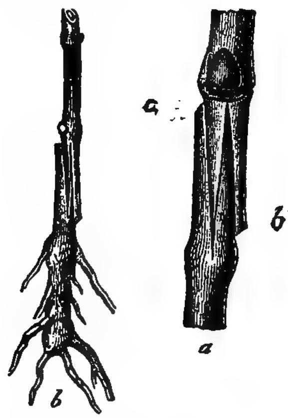


FIG. 124.—The Champin graft. (From Foëx.)

The manner of making this graft is better shown in the accompanying figure (Fig. 122).

The other forms of grafting mentioned above are comparatively seldom used and are not particularly important in this connection. They may be briefly described as follows:

The Pontois Graft.—This graft, shown at Fig. 123, was proposed as a substitute for the cleft graft, from which it differs in that instead of splitting the stock a triangular piece is cut from one side with a knife or special gouge. The scion is made to fit this cut exactly. This graft has not given as good results as the common cleft-graft, and has been practically abandoned or replaced by the form of the cleft-graft already described and shown at Fig. 119 *b*.

The Champin Graft.—This graft is a modification of the whip graft, and the manner of making it is sufficiently indicated in the annexed figure (Fig. 124). It has the inconvenience of presenting two heels, of which the lower one (*b*), belonging to the scion, gen-

erally emits roots, and the upper one (*a*) excrescences which interfere with the union of the stock and scion.

The Saddle-graft.—Two forms of this graft are shown at Fig. 125; *a* represents the common form and *b* a modification known as the Camuset graft. The serious objection to both of these grafts in the case of their use with American stocks is the tendency to form roots subject to Phylloxera attack, at the heels of the scion, and this has led to their general abandonment by French vineyardists.

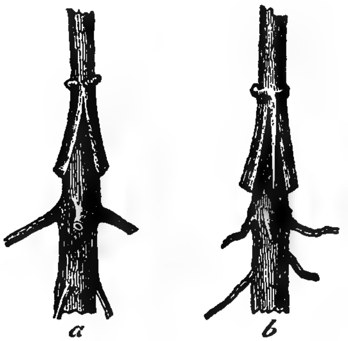


Fig. 125.—The saddle-graft. (From Foëx.)

Fig. 126.—The heel-graft. (From Foëx.)

The Heel-graft, *Fermaud Graft*, and the *Cutting* or *Slip-graft* are all similar, and are only used when it is desired to give the graft or cutting temporary support until it shall have grown roots of its own. These methods are employed frequently in multiplying American vines, and can only be employed in soil rich enough to support new stock at the very spot where the old vine grew.

The nature of the grafts is shown sufficiently well in the accompanying illustration of the heel-graft (Fig. 126).

TOOLS EMPLOYED IN GRAFTING.

COMMON IMPLEMENTS.

The saw, hammer, and chisel used by the French grafter are figured below (Fig. 127). The hammer is constructed to be employed also as a pick, with which to clear away the soil from the stock. Knives of various forms are the ordinary grafting implements in France, as everywhere else, and a number of the common styles are herewith shown (Fig. 128). The French have invented, however, a considerable number of machines which are intended to take the

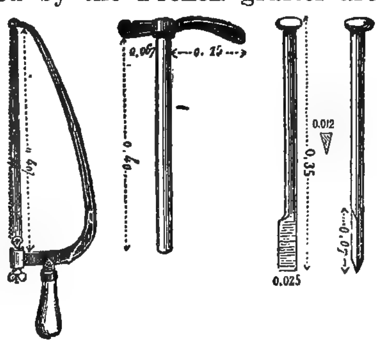


Fig. 127.—Grafting saw, hammer, and chisel. (From Foëx.)

place somewhat of the skilled workman with a simple knife. Some of these are very complex and others comparatively simple. Few of them have come into very general use, for the reason that they are costly, and that it is not possible to do better or faster work with them than with the grafting knife always ready in the pocket of the vineyardist.

The Prades Knife.—Before taking up the more elaborate implements, attention is drawn to the Prades knife (Fig. 129) already shown in part in Fig. 122. It is intended to be used in making the whip-graft, and the back of the blade is graduated to afford a means of determining the point at which to begin the longitudinal cleft, as shown in Fig. 122. This knife is employed in connection with what

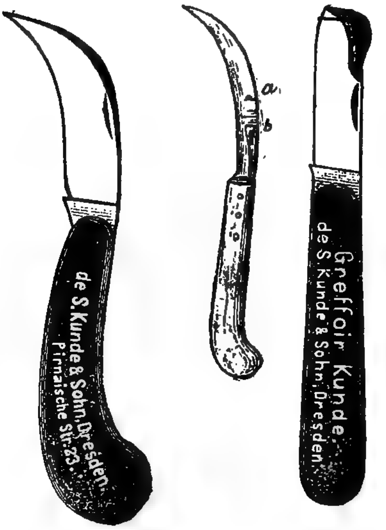


FIG. 128.—Grafting knives employed in France. (From Sahut.)

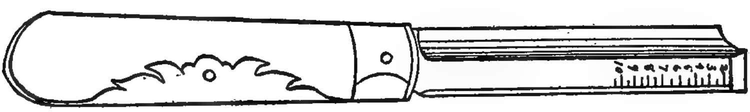


FIG. 129.—The Prades grafting knife. (From Portes et Ruyssen.)

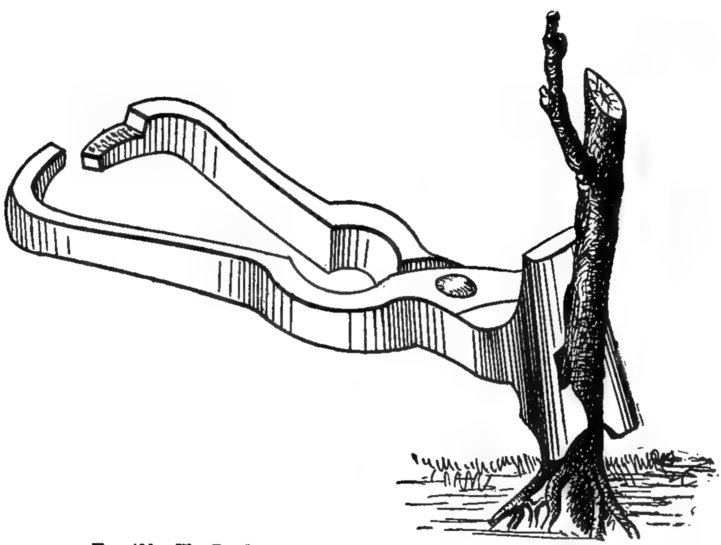


FIG. 130.—The Prades grafting guide. (From Portes et Reyssen.)

may be termed a guide (Fig. 130), which, when applied to the stock, gives the proper angle (17°) and at the same time the diameter of the stock is indicated by the graduation on the handle, so that it is possible after the preparation of the stock to select a graft of the same diameter. This device may be used to graft in the nursery or in place in the vineyard.

Petit's Machine.—Among the many devices for grafting, Petit's machine (Fig. 131) is one of the best.

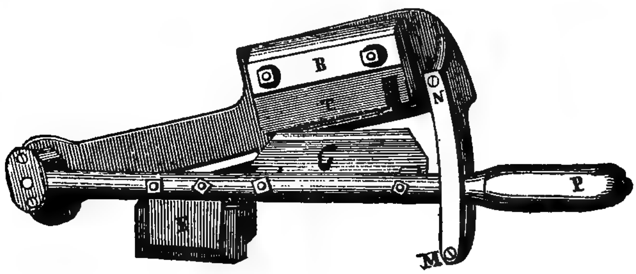


FIG. 131.—Petit's machine. (From Foëx.)

Two knives C and F corresponding respectively to the two operations in the whip-graft—the oblique cut and the small cleft—are carried on opposite sides of a lever P, which can be rotated within the limits of the confining slat M, N.

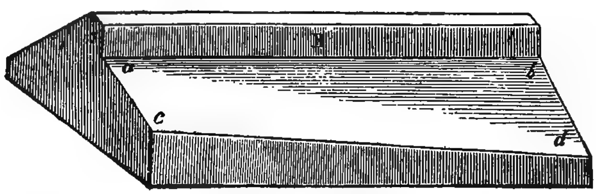


FIG. 132.—Tablet of the Petit machine. (From Foëx.)

On the tablet T, and *a*, *b*, *c*, *d* (Fig. 132), and limited above by the projection B, is placed the cutting in such position that the angle of the cut will be the same whatever the diameter of the cutting. Under the knife F is a similar tablet.

The apparatus is supported by an iron frame which is bolted to a table, and is operated by placing the cutting on the tablet T with the end against the projection B, after which the oblique cut with the knife C is made. The cutting is then placed with the cut surface pointing upward in such position that the knife F strikes it near the center and perpendicular to its axis. The lever is then moved towards the operator till a cut of the desired depth is made. This machine is designed for indoor work.

Guillebot's Machine.—This machine (Fig. 133) may be used to graft

either indoors or in the nursery. It is operated in the following manner: Place the cutting between the pincers AA, and compress it strongly enough to hold it firmly in an oblique position. To make the first cut move the lever B to the extremity of its course. The second cut, or the cleft, is made by moving the lever back to its point of departure; in continuing the movement it articulates and makes the cleft with the knife D, the depth of this cut being regulated by means of screw E.

Guillebot's Machine for Whip and Cleft grafting.—Guillebot has also invented a machine of considerable merit for both whip-grafting and full shoulder-grafting. (Fig. 134.)

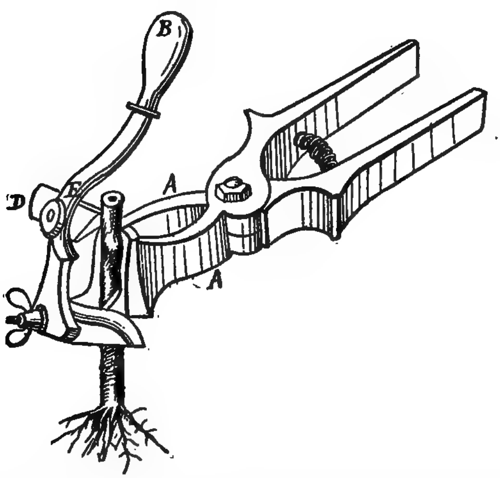


FIG. 133.—Guillebot's machine for whip-grafting. (From Portes et Ruyssen.)

To make the whip-graft the cutting is placed in the slot A and the lever B turned from left to right, which secures the cutting firmly in the slot and at the same time indicates its diameter in millimeters. To make the first cut the lever C is revolved to the right until the starting point is reached. To make the second cut or cleft the lever D is moved also to the right until it strikes against the screw which regulates the depth of the incision.

The full shoulder cleft-graft is made as follows:

The graft is placed in the slot G, with its end against the base of the slot, and compressed with the lever B as in the former instance.

The first cut is made by revolving the lever C from right to left; the graft is then turned over, and the extremity of the first cut is supported against the inclined space H, and the lever C is operated as in making the first cut.

The graduated grooves 6, 7, 8, 9 are used in making the cleft in the stock. To make the cleft an arresting pin is inserted in the open-

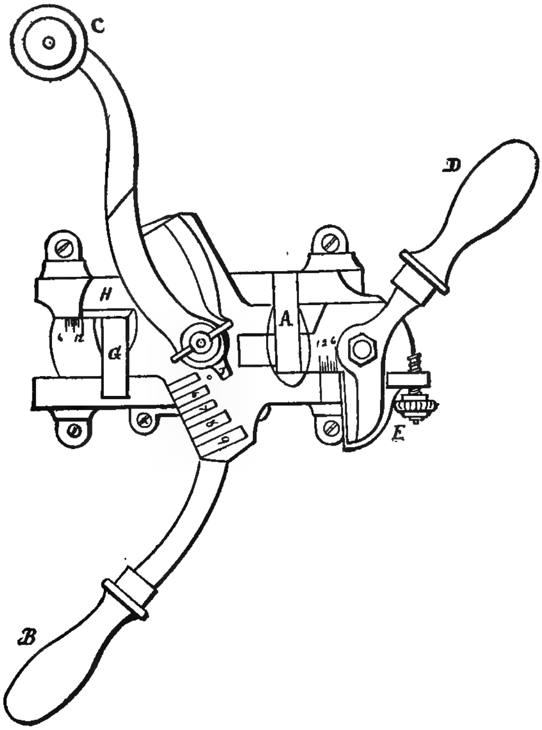


FIG. 134.—Guillebot's machine for whip-grafting and cleft-grafting. (From Portes et Ruyssen.)

ing and the stock presented in the groove corresponding to its diameter and the lever C is revolved until it strikes against the pin first mentioned.

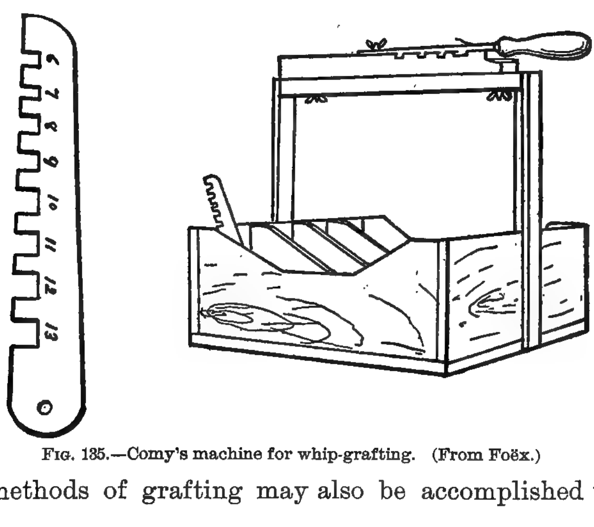


FIG. 135.—Comy's machine for whip-grafting. (From Foëx.)

Other methods of grafting may also be accomplished with this machine.

Comy's Machine for full shoulder Cleft-grafting.—This machine is, for full shoulder cleft-grafting, what Petit's is for whip-grafting in the sense of its practical utility and general adoption. The machine comprises a gauge, a graft-carrier or box, a device for fashioning the graft, and a knife to split and measure the stock.

The gauge (Fig. 135) is provided with a number of slots ranging from 6 to 13^{mm} in width; and is used to measure the diameter of the grafts. The graft-carrier (Fig. 135) is of wood, and is divided into eight compartments, in which the grafts, classified according to size by the gauge, are placed, and carries on the raised portion or handle the grafting device, which is shown enlarged at Fig. 136. The part of the blade next to the handle is guided between two horizontal bars of brass, which insures a regular section. In the wooden frame above which the blade moves are a number of inclined notches of different widths, in which the grafts are placed to be cut and which are numbered to correspond to the gauge.

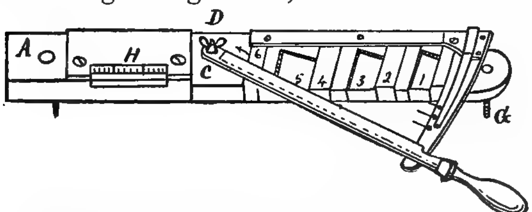


FIG. 136.—Comy's machine, showing apparatus for making graft. (From Portes et Ruyssen.)

The knife used in splitting and measuring the stock is shown at Fig. 128.

With this apparatus grafts of the proper size for any stock are readily found, and the fashioning of the graft or scion is accomplished with mathematical accuracy.

Richter's Grafting-guide.—A simple device used in the making of the whip-graft has been invented by M. F. Richter. It consists of simple brass tubing cut obliquely and fixed to a solid support. Each workman has three of these of different sizes before him; the cutting is placed in the tube nearest its size and the oblique cut made with the knife shown at Fig. 128. The cleft is made by hand with a similar knife, and commonly by a woman assistant.

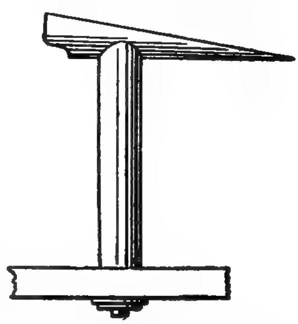


FIG. 137.—Richter's grafting guide. (From Portes et Ruyssen.)

None of the machines serving to graft in place, that is, in the nursery or vineyard, have come into common use; and it may be said in general that hand-grafting is gaining ground constantly as the number of expert grafters increases; and experience has demonstrated that with the exception of the grafting-guides similar to the one just described it is quite as difficult to get a workman to do satisfactory and skillful work with a machine as it is to do the same with a simple knife.

BANDAGES AND LIGATURES.

To be of any value cements and bandages should last till the knit-

ting of graft and stock has been completed, and but very little longer. Raphia, a fibrous product of Madagascar, and rubber bands are used in whip-grafting. In common shoulder-grafting and especially in full shoulder-grafting the bands should be prepared and applied with great care, so as not to displace the cutting. Other cloths and bands are used, but raphia and caoutchouc are recognized as the best for this purpose.

For field work plastic clay or loam is generally used to cover the graft at the point of contact with the stock. L'Homme-Lefort's resinous mastic seems to be the best composition for open-air application, and all chinks should be closed with it. In whip-grafting a very thin layer of clay is sufficient.

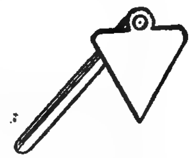


FIG. 138.—Hoe used in earthing up grafts in South France.

It is deemed highly advisable to put around the vine, after grafting, bandaging, and cementing, and before closing up the opening at the foot of the plant, a guard of stakes to prevent the shaking of the graft or bruising the bark of the stock by the passing to and fro of workmen. The stakes also serve as supports on which to fasten the young canes.

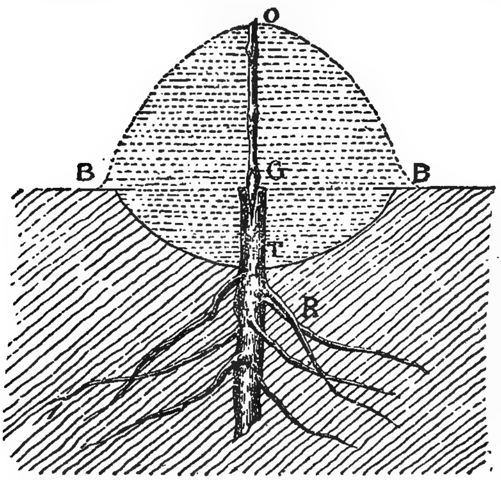


FIG. 139.—Shoulder-graft, showing method of earthing up. (From Sahut.)

Hilling up the Graft.—Ordinary hilling or earthing up consists in putting back the soil taken out to allow the operation of grafting and the addition of enough other earth to make a mound around and above the point where grafting took place. Where the soil is well aërated and sufficiently dry, or when it is moist and sandy, hilling up is easy of accomplishment, but ought never to be done during rainy weather.

In transforming a plantation of a certain sort of vine to more desirable varieties, grape-growers formerly grafted as low as possible. For this purpose the ground was hollowed out around the stock and the graft made below the level of the soil; but since the era of the Phylloxera it has become inadvisable to graft so low, as the secondary rootlets springing from the scion would shortly be infested by the rootlice. It is, however, inadvisable to graft too high, as the necessary earthing up could be performed with difficulty, and in the event of a drought the heat would be more liable to dry and crack

the mound of earth permitting free access to rain, to the injury of the cementings and bandages.

Care of the Grafts.—Over-development of the young shoots from the graft in the first season is attended with certain dangers. The graft is liable to be loosened either by the weight of the vine or by the wind. The best means to avoid this danger is to fasten the young shoots to the protecting stakes mentioned above by cords or raphia attached to them. Pinching is often resorted to to turn the growth into the secondary shoots.

If the scion is not capable of receiving and assimulating the full quota of the sap that passes through the stock, and this is more apt to be the case if it has been set in May or April, shoots will arise from the stock. At first the only thing done is to cut them off as they appear, or with a slender knife, such as is used in gathering asparagus, to clip them a short distance below the surface of the mound. When the graft has grown strong enough, that is, when its canes have been fixed to the pegs around it, the hill may be broken away on one side and the under shoos thus reached and broken off and the roots which have probably developed at the base of the scion, particularly if the soil is rich and free, removed, after which the hill may be reduced one-half without ill effects.

It is perhaps advisable to wait until the second year after grafting to lay bare and manure grafted plants.

It happens frequently that there exists a difference of diameter between the graft and stock. With the Riparia this difference is more pronounced, and the stock after a few years becomes sickly and weak. To overcome this difficulty annular incisions penetrating as far as the first layers of wood are made near one another on the stock, which results in the promotion of the growth of cellular tissue around the gashes and directs the flow of descending sap to these points. Another method consists in letting a shoot develop just above the graft to absorb some of the overabundant nutriment of the scion.

The same causes that produce inequality of scion and stock induce round swellings at the suture, and this is especially characteristic of the Riparia. It may, in general, be reduced by slashing it lengthwise, or if the protuberance is very large sections of it may be removed, two wedge-shaped fourths of it opposite each other being cut out.

Places for Grafting.—Having briefly reviewed the several methods of grafting generally employed in the reconstruction of French vineyards, there is still to be noted in this connection the place of grafting, viz, vineyard grafting, nursery grafting, and indoor grafting.

Vineyard Grafting.—The grafting of cuttings of one year's growth originally set in the vineyard where the vine is intended to be grown

presents the advantage of obviating all transplanting and consequent retarding of the full development of the vine. It has disadvantages, however, in the irregularity of the vineyard from the failure of certain cuttings to root or later in the failure of some of the grafts. In spite of these objections this method is very generally followed in south France and it is the custom to graft in nursery rows a number of plants to supply the place of any that may fail in the vineyard.

Nursery Grafting.—In south France, also, very good results are obtained by grafting in the nursery yearling plants, transplanting them to the vineyard one year afterwards. This method has the advantage of diminishing the expense of grafting and of affording an opportunity of selecting vines of equal strength and vigor for vineyard planting. The transplanting delays the fruiting of the vine one year.

Indoor Grafting.—Outside of the olive region or the extreme south of France grafting in vineyard or nursery generally results badly, on account of the prevailing cold and wet springs, which also make it very disagreeable to work out of doors. Indoor grafting may be done during the entire winter either on rooted plants or cuttings, and very much more rapidly than field work, and is generally preferred in climates where a warm, dry spring is not assured.

The grafts are planted in a nursery and on the year following are again transplanted into the vineyard.

Grafting on Cuttings.—In the foregoing discussion grafting on rooted stocks only, either in place in the vineyard, in the nursery row, or indoors, has been considered.

If the cutting is planted in the vineyard at once and grafted there after it has rooted there is no checking of growth as there is in the case of removal of the rooted cutting to the grafting room or transplanting from the nursery; and the vine comes into full bearing at least a year earlier than it otherwise would.

Another method of hastening the production of bearing vines, and one coming into very general use, is to graft cuttings directly. This method of producing vines grafted on resistant stock requires greater precautions and the percentage of success is of course much less than in the case of grafts on rooted stocks, but the advantages belonging to it outweigh the disadvantages and have given it an important place in French viticultural methods. These grafts can be made indoors and with machines during the entire winter and are preserved in moist sand until they are to be planted; and it is possible to have a plant grafted and rooted within one year or by forced culture within a few weeks. The decrease in the price of American cuttings by reason of their greater abundance renders less serious the loss of more or less of the grafts; and by reason of the constant improvements in grafting-machines and methods this loss is steadily diminishing.

In the moist regions this method of grafting works very well, but in the drier Mediterranean regions it is necessary to irrigate.

The cutting to form the stock is given a length of two or three buds and is whip-grafted with a scion of a single bud. The graft is wrapped with a leaf of lead, which is itself secured with a band of rubber and raphia, or raphia is used alone. The cuttings thus grafted are planted in rows in furrows nearly as deep as the grafts are long; at the base of the cuttings is placed a little sand to facilitate the rooting. The grafted cutting is then entirely covered with fine earth.

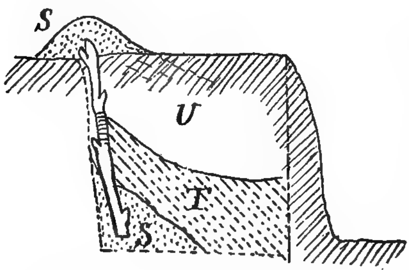


FIG. 140.—The Vermorel system of planting grafted cuttings. (From Portes et Ruyssen.)

In the Rhône districts V. Vermorel, of Villefranche, has had excellent results with grafted cuttings by planting them in the following manner:

Trenches are opened in the nursery 25 to 30 centimeters deep by 20 wide, and at the bottom of the slanting side a little sand is placed. In this sand (Fig. 140) the cutting is placed supporting it against the slanting face of the trench.

The cutting in place, the trench is filled up to the level of the graft (Fig. 140 T) and the earth is thorougly settled and watered a little. The trench is then filled to the level of the ground with earth taken from the trench following, and finally a ridge of sand is made along the row over the tips of the cuttings.

GRAFTING SCHOOLS.

Owing to the many new modes of work necessitated by the condition under which viticulture in France has of late been placed, the establishment of schools to enable vine-growers to meet the novel circumstances was hit upon in the first instance by the Société de Viticulture de Lyon. Its example has been largely copied and the results obtained prove the wisdom of the departure. A class of diplomated specialists has come into being and their work in almost every part of Europe has considerably improved viticulture.

One school, devoted exclusively to women, has turned out remarkably skillful graduates and established conclusively the aptitude of women for grafting. The endowment of such schools in every viticultural center would promote viticultural interests more than any other means, above all in those districts where the restoration of the wine land has become, or is likely to become, necessary by reason of the losses occasioned by the Phylloxera.

AMERICAN VINES IN EUROPE AND PARTICULARLY IN FRANCE.

The very general resort to American stocks and vines since the advent of the Phylloxera trouble in France has greatly changed viticultural methods, and a consideration of the subject of American vines, always of first importance to the French vineyardists, will have a value for us, particularly in view of the similar conditions found in California to those of France.

The comparative immunity of American vines from the Phylloxera has been explained in various ways. The discovery that the root-inhabiting Phylloxera of France was of American origin made by me in 1871, proving beyond all doubt that the Phylloxera was introduced into France from this country, led me to explain the resistance of American vines by their having been subject to the attacks of the Phylloxera from time immemorial and thus having by natural selection acquired resistant qualities, and these consist, on the authority of Foëx, not so much in the greater vigor of the plants or in the presence in the roots of resinous matters objectionable to the Phylloxera, as in the nature of their cellular structure. The sections of roots illustrating his important work and upon which his theory is based certainly indicate a much denser exterior in the roots of *Vitis riparia*, *rupestris*, *æstivalis*, etc., than in the European *V. vinifera*.

Vines of the *labrusca* class being, as is well known, less resistant than other American vines, were found to be intermediate in structure, and the greater susceptibility of hybrids is explained in the same way. The fact, however, that certain varieties, like the Jacquez, when grown direct, resist the Phylloxera but fail in the same soil to do so as stocks, and also that varieties resistant in one locality lack that quality in another, as, for instance, the Clinton, shows that there is room for more extended observations and experiment on this point.

The cultivated vines of this country are not derived from a single species, as in the case with those of Europe, but from a considerable number of species. Several of these have an interest purely botanical and need not be discussed here. The American species of practical importance to the viticulturist are the following: *V. æstivalis*, *V. riparia*, *V. labrusca*, and *V. rupestris*.

The Æstivalis Class.—The different varieties derived from *V. æstivalis* are commonly employed in France for direct production on account of the superior quality of their fruit. They are not easily propagated from cuttings and are usually grown on stocks of other species. The varieties ordinarily grown and most highly prized in France are the Jacquez, Herbemont, Black July, and Cunningham.

The Riparia (*Cordifolia*) *Class.**—The varieties of *Vitis riparia*, both wild and cultivated, are used, almost exclusively, as resistant stocks in France, for which they easily take first rank. They are remarkably suited to this rôle, not only by reason of their power of resisting Phylloxera attack, but by the ease with which they may be grown from cuttings and afterwards grafted.

The following varieties have been shown to be especially adapted to this use in practice:

(1) The wild varieties; (2) the cultivated varieties—Solonis, Clinton, and Taylor.

The cuttings of the wild varieties of *riparia* are imported in large quantities into France from the Mississippi Valley States. The innumerable varieties of this species have been grouped into four principal races by Foëx as follows:

(1) *V. riparia* tomentous; (2) *V. riparia* glabrous, leaves thin; (3) *V. riparia* glabrous, leaves thick; (4) *V. riparia*, leaves small.

The tomentous varieties are those of which the leaves and young branches are covered with down; they are of vigorous growth and furnish stocks of good diameter for grafting.

The glabrous thin-leaved varieties are remarkable for the great hardness or firmness assumed by their roots at an early age and their freedom from Phylloxera.

The varieties sold under the names Riparia Fabre and Riparia Martin des Pallières are highly prized by viticulturists.

The glabrous varieties with thick leaves are supposed to be hybrids of *V. riparia* with *V. cordifolia*, and include the important variety known as Scuppernong of the *Jardin d'Acclimatation*. It is remarkable for its resistance to the Phylloxera and Chlorosis and for its vigor, and is considered to be one of the best of stocks.

Of the cultivated varieties the Clinton, generally considered to be a direct descendant of *V. riparia*, was the first variety to have been noted as resistant to the Phylloxera, and is now in France of all the resistant American stocks the most widespread. It also furnishes an excellent wine.

The Taylor, considered (but in my judgment erroneously) to be a

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* The species *V. riparia* and *cordifolia* are united for convenience only. *V. cordifolia*, long confounded with *V. riparia*, is shown to be a distinct species by Dr. Englemann and especially by M. Millardet. Planchon, in his *Vignes Américaines*, disposed of the matter by assigning *V. cordifolia* to species rank and dividing it up into three varieties, two wild: (1) Var. *a*, *genuina;* (2) var. *b*, *riparia;* and one cultivated variety, *c*, Solonis (*Traité de la Vigne*, Porter et Ruyssen, 1886, Tome I, p. 322). However, in his monograph of the *Ampelideæ*, in De Candolle's great work. Planchon considers *cordifolia* and *riparia* as distinct species, and Solonis as a variety of the latter, or rather a hybrid of uncertain origin.

V. cordifolia is rare in cultivation because of the great difficulty of propagating it by cuttings. Plants in botanical gardens have generally been obtained from seeds.

hybrid of *V. riparia* and *V. labrusca*, resists the Phylloxera very well and is easily propagated, but does not do well except under very favorable conditions of soil and climate.

The Solonis is probably either a wild race of *V. riparia* or a hybrid of that species. It is the variety which best resists the Phylloxera, but is absolutely valueless for wine on account of the acidity of its grapes. As a resistant stock, however, it holds first rank and will thrive even in very moist soil, where other varieties of *riparia* fail.

The Rupestris Class.—This group includes only wild varieties which have not yet been studied sufficiently to determine their merits. They are of little or no value as wine grapes, but are easily propagated from cuttings.

The Labrusca Class.—The varieties of *V. labrusca*, while resisting the Phylloxera better than the vines of Europe, are inferior in this respect to other American vines. Certain varieties may be grown successfully in France, but others (Isabella and Catawba, for example) succumb to the root louse. The foxy taste of the fruit is also a decided objection to their growth direct. They are generally employed therefore as stocks, for which they are inferior, however, to the *riparia*. The only variety grown to any extent for its fruit is the Concord.

Hybrids.—Of the many valuable hybrids produced by various American viticulturists by crossing native species or varieties, or by crossing these with European sorts, a considerable number have been adopted in France as of value either for fruiting direct or for use as stocks. Other hybrids, found in a wild state in this country, have also been adopted for resistant stocks.

Of these varieties the important ones grown direct for their fruit, or particularly wine, are the Eumelan, Othello, Canada, Cornucopia, and Senasqua.

Those employed as stocks are the Elvira, Noah, Triumph, York-Madeira, Vialla,* Champin, and Cordifolia-rupestris.

ADAPTATION OF AMERICAN PLANTS TO THE SOIL.

A vine which demands certain conditions of soil and climate in its native country will not be likely to thrive under different conditions when transplanted to some new country. When the nature of the vines is not consulted loss of time and capital will be apt to result. The matter of adaptation is very intricate, and to fulfill its requirements instruction under thoroughly versed men is essential. French vineyardists have not been slow to detect this necessity, and throughout France to-day schools for instructions in the care and needs of the American vine are springing into existence and sending out regular graduates to act as teachers of this new phase of the industry

*The Vialla, perhaps, of all the stocks employed in France gives the greatest percentage of successful grafts and affords the best results in grafting on cuttings.

in all parts of the country. Most beneficial results have been achieved. Could this have been done long ago much useless expenditure might have been avoided, and the poor grape-grower who caught at any hope to preserve his failing vines would not now in so many instances have felt disposed to curse the American stock as the source of all his troubles.

In general it may be said that American vines grow best in new land which is deep and permeable, in alluvium or in soils mixed with sand and pebbles. The color of the soil appears to exert some influence. Red soils are especially favorable, gray soils less so, and white soils are positively injurious.

The various varieties of grapes behave quite differently in diverse soils, and often even in the same region or in neighboring regions certain varieties present very contradictory results.

L'École de Montpellier has formulated the statement quoted below which will be of interest as giving the various classes of soils together with the American vines best adapted to each :

(1) New deep fertile soils : *Riparia tomentous and glabrous, Jacquez, Solonis, Vialla, Taylor, Cunningham.*

(2) Deep soils, somewhat strong, not wet : *Jacquez, Riparia, Solonis, Cunningham, Vialla, Taylor.*

(3) Deep soils of medium consistency, new and not dry in summer : *Riparia, Jacquez, Solonis, Vialla, Taylor, Black July.*

(4) Light pebbly soils, deep, well drained and not too dry in summer : *Jacquez, Riparia* (wild), *Taylor, Rupestris.*

(5) Calcareous soils, with subsoil shallow or granitic: *Solonis, Rupestris.*

(6) Argillaceous soils, white or gray : *Cunningham.*

(7) Argillaceous soils, deep and very wet : *V. cinerea.*

(8) Deep, sandy, fertile soils : *Riparia* (wild), *Solonis, Jacquez, Cunningham, Black July, Rupestris.*

(9) Light, pebbly soils, dry and barren : *Rupestris, York-Madeira, Riparia* (wild).

(10) Deep soils with a tufa base and salt lands : *Solonis.*

(11) Soils formed of débris of tufa, but sufficiently deep: *Taylor.*

(12) Ferruginous soils, containing red pebbles of silica, deep and somewhat strong, well drained, but fresh in summer; all the varieties indicated, and in addition *Herbemont, Clinton, Cynthiana, Marion, Concord, Herman.*

PRESENT STATUS OF AMERICAN VINES.

A fact now patent, but not readily admitted by French grape-growers, is that American species yield at least one-third more than the foreign, though those who admit this fact claim that the wine product is inferior, which may be true or not for the simple vine, but which is assuredly not true of the grafted plant.

The reputation made by American stocks when first introduced is still maintained, and each year shows an increase in the acreage of vineyards reconstructed by their use. The future outlook is bright, and it is predicted that the time is not far distant when viticulture will be as widespread in France as it was before the appearance of the Phylloxera.

The following tabular statement drawn from the recently published report of the Superior Phylloxera Commission will be interesting in this connection:*

Years.	American vines covered.	Departments.	Years.	American vines covered.	Departments.
	Acres.			*Acres.*	
1881	22,260	17	1886	276,992	37
1882	42,740	22	1887	413,792	38
1883	70,030	28	1888	536,967	43
1884	131,949	34	1889	719,502	44
1885	188,230	34			

If the march of the recovery continue at this ratio, in four years vine-planted land in France will reach the unprecedented amount of 6,500,000 acres. Hérault presents 380,000 acres of renewed vineyards; Aude, 68,000; Gard, 60,000; Gironde, 47,000; the Western Pyrenees, 75,000, and Var, 47,000.

The efforts to produce by hybridization Phylloxera-proof varieties have so far not proved successful or popular, as most growers still depend on grafting on the American stock. Another noticeable fact is that the Government does not hesitate in its liberal policy of doing all in its power to aid the afflicted vine-grower, and the law of December 1, 1887, by which the land tax on newly planted or restored vineyards is remitted for four years, is still in force.

DISEASES OF THE VINE.

The cryptogamic diseases of the vine in Europe, and especially France, are practically identical with those occurring in this country and are in fact largely of American origin. The methods of successfully treating these diseases are mostly of French discovery, and although they have in general been brought to the attention of American viticulturists, a brief consideration of the subject of remedies in connection with the various diseases will not be out of place in this Report.

The important diseases are the Mildew, Black Rot, White Rot, Oïdium, Anthracnose, and to those may be added Pourridié.

Downy Mildew.—The grape disease, attacking the leaves green stems, and fruit, known as Mildew or Peronospora (*P. viticola*), is indigenous in America, where it occurs abundantly from Canada southward and westward, excepting in California, Oregon, Arizona, and New Mexico. It was first noted in Europe in 1878 by Prof. Planchon, but has now become very widespread and has invaded practically all the Mediterranean region, including Spain, France, Italy, Greece, and Algeria. The effects of this disease are especially grave in Europe. Vines attacked with Mildew ripen their fruit

* *Insect Life*, II. p. 310.

badly and give wine lacking in alcohol and color, and without solidity.

American grape-growers are, of course, thoroughly familiar with this Mildew, and hence any description of it will be unnecessary.

The practical remedies that may be employed against the Mildew have been concisely summarized by Pierre Viala in his important work, "Les Maladies de la Vigne," and revised in the "Manuel Pratique pour le Traitement des Maladies de la Vigne" (1888), by Viala & Ferrouillat, from which the following is drawn:

(1) When possible vines least subject to the mildew should be chosen in the construction of a vineyard. (Among the more resistant varieties originating from *V. vinifera* are the Persian Grapput, Pignon, Sauvignon, Semillon, etc.; among the American varieties the Cynthiana, Elvira, Noah, Montefiore, Missouri Riesling, and Herbemont.)

(2) The collecting of the leaves in autumn, plastering with concentrated solutions before the starting of the buds, and the removing of the parts first attacked by the mildew, are all without value.

(3) All efforts against the mildew in full development are useless even with the substances which give at other times the best results.

(4) The mildew can only be arrested by preventing its spores from germinating on the grape leaves; the remedies ought therefore to be applied before the appearance of the spores on the green parts of the vine.

(5) The salts of copper, applied as preventives only, have given completely satisfactory results.

(6) Treating vine supports or stakes with the sulphate of copper may be employed as an auxiliary means; in regions where the vine is ordinarily fastened to stakes it is well to coat the stakes in a solution of 10 parts of sulphate to 100 of water before setting them.

(7) Powders having a base of sulphate of copper of about 10 per cent need to be still further tested before they can be recommended for general use.

(8) The *eau celeste* and the *bouillie bordelaise* should be employed in preference to all other mixtures.

The *eau celeste* is prepared by dissolving in a wooden vessel 1 kilogram of pure sulphate of copper in 3 liters of warm water; when the mixture has cooled, 1½ liters of the ammonia of commerce are added. This solution, prepared at least one-half day in advance, is diluted to 200 liters just before being employed. It is necessary to use 200 to 300 liters, at least, per hectare for each treatment.

The *bouillie bordelaise* is made by wetting 1 kilogram of strong quicklime in 5 liters of water and adding the mixture to 100 liters of water in which has been dissolved 2 kilograms of sulphate of copper. It is applied, as in the case of the first mixture, at the rate of 200 to 300 liters per hectare.

(9) The first application of the *eau celeste*, or *Bouillie*, is made about May 15, or as late as the 18th of June in the northern districts without any danger of injury to the bloom. A second application is made one month and a half after the first, and a third treatment about the first of August. In very bad years four or five treatments are sometimes necessary. When possible the final treatment should be made fifteen days before harvest.

In using the powders the first application should be made about May 15, and the treatment should be repeated at least four times.

Black Rot.—The Black Rot (*Loestadia bidwellii*) began its ravages in France in 1885 in the submerged vineyards of Hérault, and has

spread rapidly since that time. It was introduced from the United States, where it exists in all the vineyards east of the Rocky Mountains, California thus far enjoying complete freedom from its attacks.

In this country it prevails on both cultivated and wild varieties and is the worst scourge of our vineyards, few vines being capable of withstanding its attacks. The losses resulting from this disease amount frequently to from 75 to 90 per cent of the crop. In France the Black Rot is less serious than with us and is not so widespread nor so destructive as the mildew. In moist districts, however, the losses have amounted in some instances to three-fifths of the crop. A warm, moist climate is essential to this disease in a higher degree than in the case of any other like ailment except the kindred bitter rot. Black Rot first affects the leaves, afterwards passing to the fruit. The efforts of French viticulturists for the extermination of this rot have been almost without avail, though much industry has been shown in diagnosing its symptoms and characters and prescribing tentative or presumptively remedial treatments. Powders, sulphur, plaster, ashes, slaked lime, coal dust, solutions of lime, phenic acid, and carbonates have all failed in turn. Nevertheless the conviction has been gaining headway that cupric compositions will eventually get the upper hand of black rot, especially if used at an opportune moment and in sufficiently large doses.

Experiments recently made by the mycologist of the United States Department of Agriculture, have shown that if the salts of copper (Eau Celeste and the Bordeaux mixture) are applied before the fungus of Black Rot has become established on the foliage, in advance of the period of bloom even, and repeated at intervals of 10 to 15 days, the disease may be kept entirely under control. Eau Celeste proves to be much inferior to the Bordeaux mixture and the latter only is given positive recommendation. Preventive measures may by employed, such as removing and burning affected branches and fruit, or protecting the fruit in paper sacks. The latter method is quite successful, but can not be applied on a large scale.

White Rot.—The White Rot (*Coniothyrium diplodiella*) was observed for the first time in 1878 in Italy. In 1885 it was discovered in France by P. Viala and L. Ravaz, and in 1887 Viala discovered it in this country in Missouri, Indian Territory, and Texas. Its being found in the Indian Territory away from all cultivated vines leads to the belief that the disease is of American origin. Its occurrence here is, however, exceptional or rare. In France the White Rot has made great ravages in several vine districts. This disease has not been observed on the foliage. It attacks the fruit especially, and sometimes the branches. No conclusive experiments with remedies have been made in either France or Italy, but it is believed that the copper solutions already referred to will prove of value against the White Rot. P. Viala records having observed in Missouri, during his recent visit

to the United States, in a small vineyard of Cynthiana vines, a portion of which had been treated with the Bordeaux mixture for the Mildew that the treated portion was practically free from the White Rot, while on the contrary in the part untreated one-fifth of the crop was destroyed by this disease.

Oïdium or Powdery Mildew.—This disease is supposed to be of American origin and occurs in this country very abundantly in all vine districts, including California, and on wild species in the forests. It was, however, first observed in England by Tucker in 1845, and was described by Berkley as *Uncinula spiralis* in 1857. It has made its way into all the vine countries of the world, and if left unchecked frequently causes great losses. In this country the popular name "Powdery Mildew" has been generally adopted. It was proposed by me in 1885* to distinguish it popularly from the other common mildew of the vine (*Peronospora viticola*) for which the name "Downy Mildew," proposed at the same time, has come into general use.

Varieties derived from the European *Vitis vinifera* are especially subject to this disease, much more so than the more robust American sorts, and in consequence the European vineyards, and in this country the vineyards of California where European grapes are grown, are the chief sufferers. This fungus attacks the leaves, appearing chiefly on the upper surface and also the young shoots and fruit.

The remedy generally employed in France, as well as elsewhere, is sulphur, which is usually applied as a powder by means of a bellows. The yearly applications of sulphur to French vines have brought this disease practically under control, and it has been found that the sulphur exerts a beneficial action on the growth of the vines. The hope that the copper salts, used so successfully against the Downy Mildew, would prove available against the Oïdium or Powdery Mildew has not been realized in the course of a large number of experiments. It is thought that the sulphur may be mixed with the powdered copper sulphates and the two applied together with bellows, thus reducing the expense of the treatment. This, however, is only recommended for the first application in the spring, it being advisable to make the later applications separately. The sulphur, then, with the exception noted, is generally applied in powder without intermixture with other substance, and is the sole practical remedy for the Powdery Mildew. The sulphur does not act as a preventive, but is a direct remedy. It is, however, held to be advisable to apply it before the disease has gained a foothold. It is impossible to lay down absolute periods at which the application should be made, since the time will vary with different years or climatic situations. In general it is the custom to make the first

*Proc. Am. Pom. Soc., 1885, p. 49, and Rural New Yorker, Jan. 30, 1886.

application when the young shoots have reached a length of about 10 centimeters. A second sulphuring is given the vines at the moment of blooming, and this application is considered the most important and necessary of all. This period is especially favorable for the development of the fungus, and it is very desirable that the spores be kept from the flowers and ovaries, and in northern France this is commonly the first application made. These two applications, if made regularly year after year, will generally be sufficient, but it will be frequently necessary to make additional applications between the setting of the fruit and its maturity—a period during which the disease is particularly liable to appear in force if the favoring conditions of cold and moisture occur.

Viala and Ferrouillat, in the work cited above, give the following periods for applying the sulphur:

(1) When the young branches are about 10 centimeters long.

(2) Always and particularly at the moment of blooming.

(3) Give a third treatment a few days before the fruit reaches full size.

(4) Make as many applications between the above as shall be necessary.

Anthracnose.—The Anthracnose (*Sphaceloma ampelinum*) is one of the oldest known diseases of the vine in Europe and appears to be indigenous there. In America it was first discovered in 1881 by Burrill, but has since been found to be quite widespread in vineyards from New Jersey to California and also occurs in our forests on wild vines in such manner as to indicate that it has long been present on this continent, if, indeed, it is not a native species.

Its ravages are much less severe both in Europe and America than those of the diseases already noted, but in warm and moist districts it is not infrequently abundant and destructive. It attacks all the organs of the vine during the growing seasons and occurs in three forms, viz, maculate, punctate, and deforming. The maculate form is the more common, the others being comparatively rare. The same methods of treatment are applicable to all. Many remedies have been recommended and tried, most of them unsuccessfully. Repeated sulphur treatment, or the use of lime and compositions of lime and sulphur or plaster and powdered sulphate of iron have given but partial results, but always beneficial. Concentrated sulphate of iron or dilute acids applied as a preventive wash in the spring before the starting of the foliage are usually successful. Sulphur produces the best results at the beginning of vegetation and should reinforce preventive treatment if the slightest signs of the evil appear or if the attack of Oïdium the year before was severe. According to some writers sulphur is most efficacious after a light rainfall or heavy dew, but this view is contested by others, who hold that the most satisfactory results are achieved with this material

after the disappearance of the rain or dew, since then the spores develop more rapidly and split the shell in which they generate, thus giving scope for the best action of curative substances.

Lime in the proportion of one-half is commonly applied with the sulphur, and if the disease gains ground the lime is used alone. The value of the copper salts against this disease has not been established. The removal of excessive moisture by drainage is always of value.

Pourridié.—This term is applied to an alteration in the roots of the vine, caused by the attacks of several species of fungi, which also occur on the roots of other plants. Attacked vines succumb in from fifteen months to three years, and in very humid soils the losses from this source are frequently very great. It is not uncommon in our Southwestern States and I often met with it in my early studies of Phylloxera work with which it is often confounded. It has also recently been noted in Texas and California.

Pourridié seems to result from excessive humidity of the subsoil, due frequently to underlying banks of calcareous rocks, which catch and hold the water. This is further shown by the fact that it develops in moist localities and in impermeable, argillaceous, marly soils. Originally it was supposed to be caused exclusively by the same fungus which brings about, under like conditions, the degeneration and death of many coniferous plants, the *Agaricus melleus* L., of which the mycelium was known under the name of *Rhizomorpha fragilis* Roth, but Mr. Hartig has indisputably traced Pourridié, in the majority of cases, to a different source, the *Dematophora necatrix*, essentially different from the former parasite, but seemingly analogous from the point of view of the mycelium. There are many other forms of fungus which produce the same results, but which act in more or less diverse ways. The chief manifestations of this evil are stunting of the branches and the growth of numerous shoots at and just above the level of the ground. At first the leaves keep their color, but are much below the normal size and deeply incised and sometimes much cut up. The shoots are short, partly dried up, and are covered with yellow, flossy filaments.

With reference to curative or preventive treatment little of a positive nature can be said. No remedy will save affected vines. Chemical and other substances recommended as preventives are very costly. Attempts have been made to eradicate this disease by laying bare the roots of infested vines and sprinkling them with sulphur flour, but this course terminated in the death of the plants. However, when the locality becomes dry or parched the woolly mycelium also dries up and disappears, and upon this occurrence the vine-grower must build his hope for even temporary relief. To assist the drying of the soil draining is very advantageous. But in the case of slight

attacks the pulling up of the vines and the abandonment of that part of the vineyard for a few years gives much better results and aids in checking the spread of the disease.

FUNGICIDE APPARATUS.

As will appear from the foregoing brief review of the more important fungus diseases of the vine in France the remedies are applied either as powders, as sulphur, lime, etc., or as liquids more or less thick and pasty, as with the Bordeaux mixture, or perfectly liquid, a in the case of the Eau celeste, and the sulphates of iron and copper. For the application of the first, powder-blowers of almost infinite variety are employed, and for the liquids an equally large number of pumps, syringes, etc., are used, many of which were referred to in Chapter V, on field trials of machinery, but may be more fully described here.

Instruments for the Application of Powders.—The simplest devices of this class are the common powder dusters or vessels in the bottoms of which holes are made through which the powder is shaken onto the plants. Much superior to these primitive dusters are the bel-

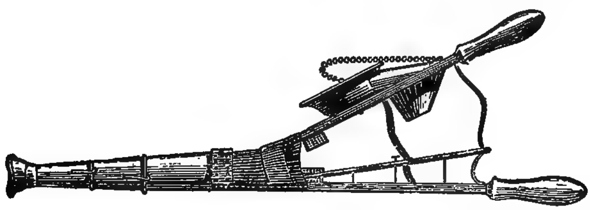

FIG. 141.—Granal-Malbec bellows. (From Viala et Ferrouillat.)

lows powder-blowers, both in rapidity of work and regularity of the application. The simple instruments in which the bellows itself is the receptacle for the powder can only be used in the application of sulphur. With other substances, copper sulphates, and lime, the leather soon becomes rotten, and even with the use of sulphur the leather is constantly injured by the action of the sulphuric acid which is always developed, and especially in the presence of moisture.

One of the best of the simple bellows and one very generally employed in southern France is the Granal-Malbec bellows, invented by M. Granal, and perfected and manufactured by M. Malbec (Béziers, Hérault, France).

This instrument is shown at Fig. 141, with the leather removed to show the construction. The powder is introduced through a funnel on the upper surface of the bellows, at the rear of which is the air valve; the blast pipe is provided with two perforated screens to regulate the distribution of the powder, and is made in three parts to facilitate the cleaning of the screens. The central support shown between the upper and lower surface of the bellows is to gauge the

amount of sulphur employed. In filling the bellows the upper face is brought down against this support and the remaining space is then filled with sulphur, thus leaving ample room for the working of the bellows.

This bellows distributes sulphur in an excellent manner if care is taken to keep it in a horizontal position to prevent the massing of the powder at the base of the blast pipe. Price, 3 francs.

For the application of the sulphates of copper it is necessary to keep the powder in a receptacle apart from the bellows for reasons already given; and the use of bellows of this class is becoming more general, not only for the substance named, but for lime, sulphur, and all the powders employed in treating the vine.

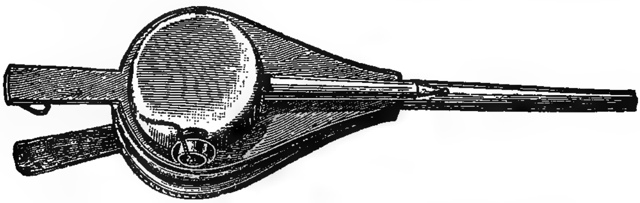

FIG. 142.—Malbec-Gilloux bellows. (From Viala et Ferrouillat.)

The Malbec-Gilloux bellows (Fig. 142) consists of an ordinary bellows to which is fastened a powder reservoir having a capacity of about one pound. A valve connects the reservoir with the bellows and prevents the powder being drawn into the latter during inflation. From the opening of this valve extends a tube, which passes

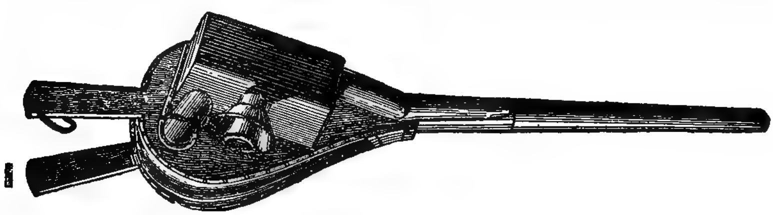

FIG. 143.—Malbec bellows. (From Viala et Ferrouillat.)

through the reservoir and connects with the blast pipe; within the reservoir this tube is partly of wire screen, so that when the bellows is worked the air draws the powder through the screen portion of the tube and thence to the blast pipe.

The Malbec bellows (Fig. 143) is similarly constructed; the reservoir is, however, divided into two compartments by a horizontal screen. The powder occupies the superior portion, and sifts through the screen into the lower part during the operation of the bellows. The blast pipe traverses the box vertically and leaves it at the upper part to guard against the waste of the powder if the bellows be pointed downward. The blast pipe in the case of the two bellows last described is either straight or curved, and in the latter style is

provided with a funnel-shaped nozzle covered with a screen. This bellows distributes the powder well, and the only objection urged against it is that in the case of the flour of sulphur its action is too slow. Price, 4 francs.

A much more effective instrument, and one suited for the distribution of all kinds of powders, is the Lagleyze bellows (Fig. 144).

It consists of a bellows S which drives a current of air into the base of the reservoir R attached to one of the faces of the bellows and from there into the blast pipe T. The reservoir is provided with a perforated plate which sifts the powder, above which is an agitator D which crushes the lumps and causes the powder to be sifted regularly. The agitator is borne upon a pivot, which is attached at *b* to the crank *c*; this crank is attached at *a* to an iron plate which is fastened to the side of the bellows opposite the reservoir. The tube C joins the lower portion of the reservoir with the blast pipe A, which is terminated by a curved fan or deflector.

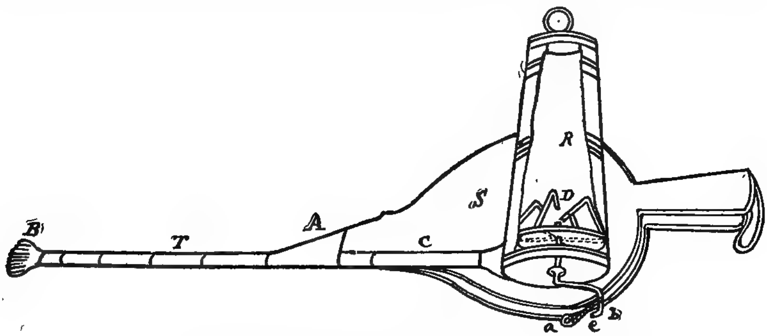

FIG. 144.—Lagleyze bellows. (From Portes et Ruyssen.)

This instrument is light, inexpensive (4 francs), and is well suited for all ordinary work.

The Albrand bellows is quite similar to the last, differing in the construction of the agitator somewhat, and gives good satisfaction with all powders. It is manufactured by M. Vallatton, Lyons, France, and its price is 4 francs.

Other bellows with exterior reservoirs are in use, which, however, do not present features not found, in principle, at least, in those already described.

The small quantity of powder carried by these bellows is an objection to their use for extended work, and to obviate this powder bags and reservoirs of metal, having a capacity of 3 to 5 kilos, are constructed, to be attached to the back of the workman. With one of these little time is lost in recharging the bellows.

To avoid the loss of time occasioned by the use of the small bellows a number of instruments of comparative large capacity have been devised, which are intended to be strapped to the back of the operator.

Of these the Pinsard apparatus (Fig. 145) is the best known:

It consists of a large reservoir in the form of a funnel containing 12 to 15 kilos of powder, which is strapped to the back of the workman. In the interior of the reservoir is a long coiled spring the

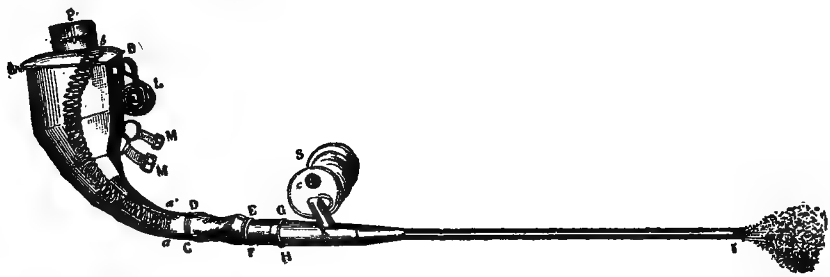

Fig. 145.—The Pinsard apparatus. (From Viala et Ferrouillat.)

vibrations of which keep the powder constantly stirred up and direct it to the lower part of the reservoir. A large leather pipe C F connects the reservoir with the blast pipe, into which a current of air is directed by means of the bellows S. In using this apparatus the operator holds the blast pipe in his right hand and works the bellows with his left. It requires some experience to operate this apparatus successfully. It is made by Malbec & Gilloux and sold for 16 francs.

Fig. 146.—The Hugentobler apparatus. (From Viala et Ferrouillat.)

An ingenious apparatus, resembling a knapsack pump, recently invented, is constructed by the society "l'Avenir Viticole." It is the Hugentobler apparatus (Fig. 146), and while it does not as yet work in an entirely satisfactory manner, it is of sufficient impor-

tance, representing a new principle, to be briefly described. It consists of a reservoir divided into two parts by a vertical partition. One of these parts forms the body of a pump of large diameter in which moves a piston with a packing of felt. The piston is moved by means of a lever which the operator works with his right hand. The air is forced into a tube at the bottom of the reservoir and from thence into the blast pipe, which is held in the left hand.

The air enters the pump through a valve in the piston itself. A second valve adapted to the distributing tube prevents the introduction of the powder into the body of the pump. The other part of the reservoir contains the powder to the amount of about 10 kilos. The powder distributer is the important feature of the apparatus and is composed of two concentric tubes attached to the base of the reservoir, in each of which is a longitudinal split or cleft. The interior tube is movable and turns in the exterior one, which is fixed. The

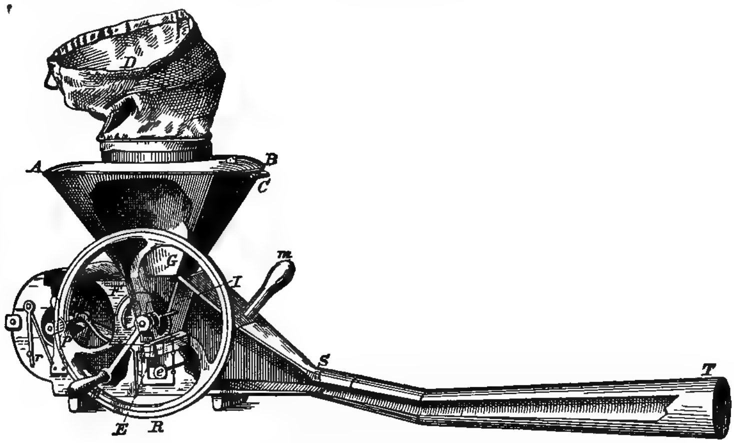

FIG. 147.—Gendre machine. (From Bull. 5, Sec. Veg. Path.)

cleft in the latter presents itself to the powder. The cleft of the inner tube normally does not coincide with that of the outer, and is held in place by means of a spring fixed to the inner tube and ending in the bottom of the pump. The piston, on its descent to the base of the cylinder, touches a lever also attached to the inner tube and turning the latter sufficiently to make the clefts in the two tubes coincide. A small amount of the powder then pours through the clefts and is carried into the discharge pipe and distributed at the next stroke of the piston. The price of this apparatus is 24 francs.

A number of fan blowers of powder are used in France, which, however, are not especially superior to the bellows blowers already described. The advantages of these machines consist in their satisfactory diffusion of the powder by means of the strong current of air generated and their regular and continuous action.

The Gendre and Trazy machines (Figs. 147 and 148) represent ordinary styles. They are composed of a hopper for the powder, a distributer, a fan moved by a crank, and a blast pipe. These instruments are fastened to the belt of the operator and are supported and directed with the left hand, the right working the fan.

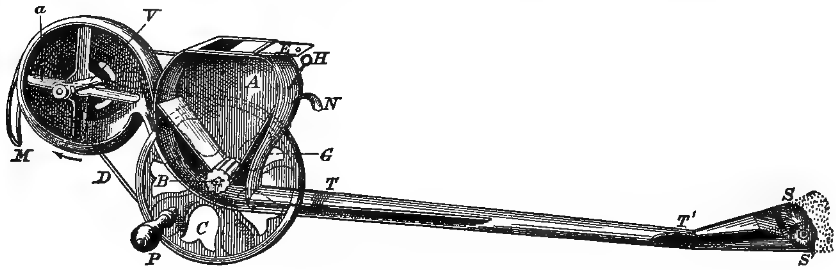

FIG. 148.—Trazy machine. (From Bull. 5, Sec. Veg. Path.)

A third machine of this class may be noted, viz., the Japy fan blower. The hopper will contain about one kilo of powder. In its axis is a vertical shaft terminated by a cone of very fine wire gauze, which closes the bottom of the hopper. The wheel that moves the fan by a suitable device imparts to the shaft mentioned above an abrupt motion up and down, and the successive shocks cause the powder to pass through the cone screen into the blast tube. The only peculiarity in this machine is the distributing device just described. The Japy apparatus is said to be the best device of its class, but the objection to it and all this style of machines is that the force required to run them for any length of time is too great.

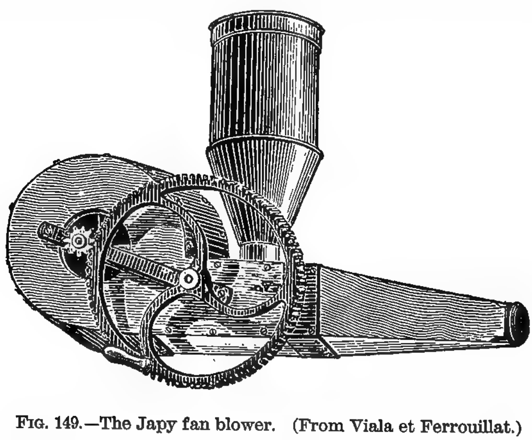

FIG. 149.—The Japy fan blower. (From Viala et Ferrouillat.)

The powder *projectors* are a class of machines somewhat similar to the last, and like them do quite satisfactory work, but are generally discarded for machines requiring less muscular exertion, such as the bellows blowers.

The Japy projector (Fig. 150.) is composed of a circular broom, turning in a drum which opens in front. The powder is caused to pass from the hopper to the broom drum by an agitator. These parts are attached to a long arm on which the cranks operating the broom and agitator are fastened, and which is joined to a belt fastening the apparatus to the workman.

A second device of this sort may be noticed. The Trazy projector (Fig. 151) is provided with the customary circular broom, which however, in addition to its projecting force by rotation, acts as a fan,

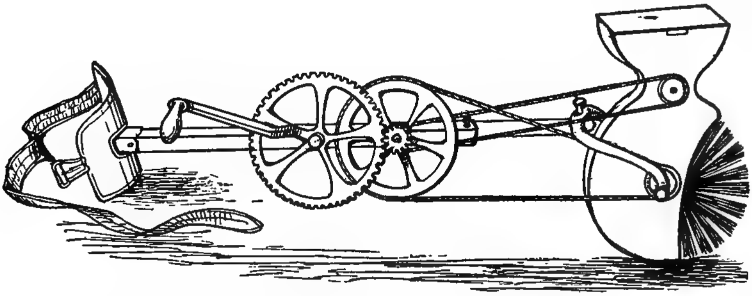

FIG. 150.—The Japy projector. (From Viala.)

obtaining air from an opening in the side of the drum. The machine is fastened by means of a hook to the belt of the workman. It is commonly employed in the district of Lyons, not only in treating the vine, but also fruit trees, etc.

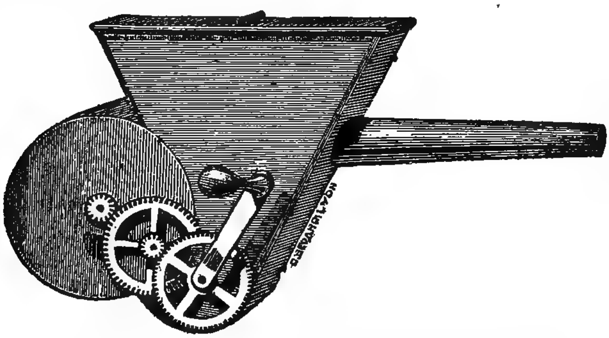

FIG. 151.—The Trazy projector. (From Viala et Ferrouillat.)

Machines for Spraying Liquids.—The simple devices for treating vines with liquids need not be described at length; they include sprinklers, simple syringes, etc. The powder projectors just described, by altering the nature of the reservoir, are also used in the application of liquids, especially in the Bordelais mixture, which is thick and pasty, and thick lime mixtures.

Much more important are the force-pump sprayers, consisting of a reservoir for the liquid, a pump either for forcing the liquid directly or by means of compressed air and a nozzle.

A host of machines of this class have been invented and placed upon the market in France within the last few years; and with every trial of spraying machines—and these are held at frequent intervals in the French vine districts—new devices are shown. The most important feature of these machines is the nozzle, as on its operation will depend the worth of the apparatus. The nozzles in general use may be classed in three groups, viz, those patterned after the Riley type, those after the Raveneau type, which are practically deflector nozzles, and the Japy type or the colliding jet. Of these the first group is by far the most important, and with few exceptions all the spraying machines are provided with some modification of the Riley nozzle.

This nozzle was conceived by me in 1879, was invented in 1880 in the course of my work against the Cotton Worm, and was introduced into France in 1884. In its simple form it consists of a stem with chamber attached, having a removable cap. Its characteristic feature is that the inlet orifice to the chamber is bored tangentially

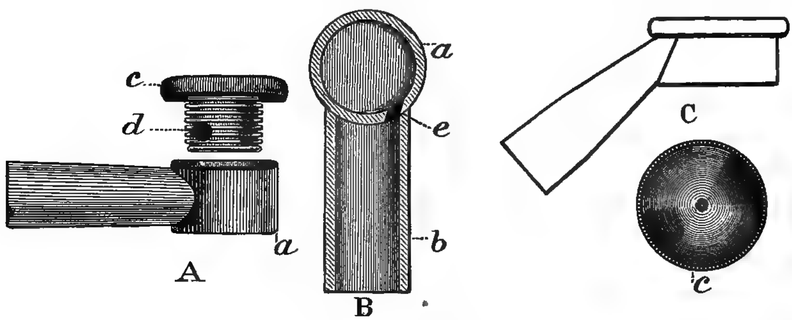

FIG. 152.—The Riley nozzle.

through the wall, so that the liquid is given a whirling motion within the chamber and is caused by this means to escape in a cone-shaped spray from the orifice in the cap. The annexed figure (Fig. 152) shows two of the forms ordinarily used in this country and also the principle of their construction.

Of the half dozen or more French forms of the Riley nozzle, the Vermorel nozzle is perhaps the most important and most generally used (Fig. 62). The important feature of this nozzle is the degorging device, which consists of a pin inserted through the base of the nozzle and capable of being pressed upward till its sharpened upper extremity enters the discharge orifice. By this means any obstruction in the discharge orifice can be easily removed, thus especially adapting this form of nozzle for use with thick or pasty liquids.

The several modifications of the Riley nozzle have been described by me recently,* and the ground need not be gone over again. The

* Insect Life, Vol. I, Nos. 8 and 9.

important modifications not already mentioned are the Noël nozzle, the Marseilles nozzle, the Japy nozzle, and the Albrand nozzle; the last two are modifications of the Vermorel type.

What is generally known in France as the Raveneau nozzle is shown entire and in section at Fig. 153. It is a deflector jet of novel construction, and consists simply of a screw cap with a small orifice, in front of which is a small concave projection. The liquid strikes against the cutter and spreads out into a sheet-like spray. Another and a rather awkward form of the Raveneau jet is shown at Fig. 154.

Both of these jets are rather primitive types and can hardly be recommended.

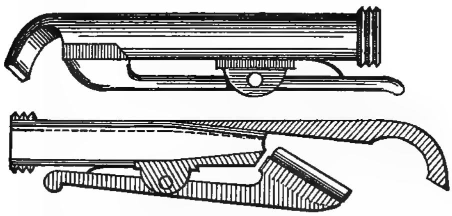

FIG. 153.—The Raveneau nozzle. (Bull. 5, Sec. Veg. Path.)

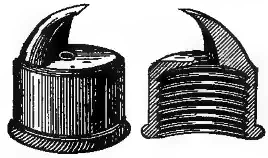

FIG. 154.—Nozzle after the Raveneau type. (Bull. 5, Sec. Veg. Path.)

The Japy type, or colliding-jet nozzle, produces the spray by causing the jets or streams of liquid to strike each other at an angle. This is shown at Fig. 63, *ante*. Both the Raveneau and Japy nozzles are constructed with degorging devices for use with thick, pasty liquids.

The objection to the larger styles of apparatus, or those mounted on wheels and drawn by means of a horse, is that the narrow space between the rows of vines does not generally permit the use of such machines. It has commonly been found preferable to employ the smaller machines, which could be carried about by the workman. Attention may, however, be called to one mounted machine, the Bosc (Fig. 155).

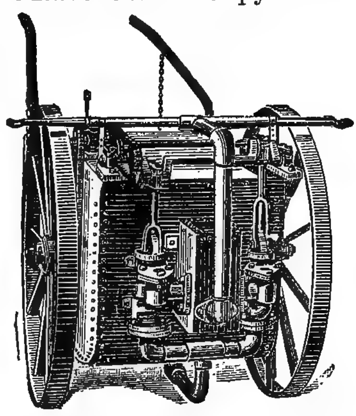

FIG. 155.—The Bosc apparatus. (From Viala et Ferrouillat.)

It is provided with a reservoir containing an agitator, and has a capacity of 300 to 350 liters. The axle of one of the wheels drives two force pumps which connect with the tank, and also above with a horizontal pipe at either extremity of which is a Raveneau nozzle. A sieve covers the opening of the pipe leading from the tank and prevents the passage of solid particles that would otherwise clog the nozzles. With this machine several rows can be sprayed at once. Its work is regular and the spray is effective. The weight of this

apparatus, making it when charged a very heavy load for one horse, and its high price (700 francs), are objections that prevent its common employment. It can be used also only in vineyards in which the rows are regularly arranged and of sufficient width and before the vines have made much growth in the spring.

The more popular knapsack pumps, of which the variety is almost endless, may be classified as follows: (1) Pumps of liquid direct, with compression air chamber; (2) air pumps; (3) diaphragm pumps, and (4) knapsack reservoir with syringe or other style of pump connected with it by means of rubber hose.

In the brief account of the trial of spraying machines held in connection with the Exposition, given in the preceding chapter, will be found some interesting information, relating, however, in considerable part, to new devices which have not yet come into general use. Attention will be given in this place rather to such pumps as have, in the hands of the French vineyardist, given satisfactory results.

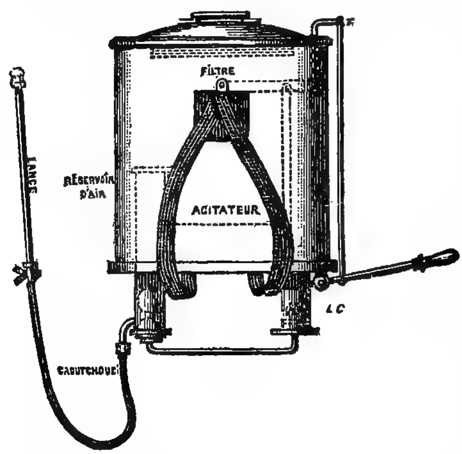

FIG. 156.—The Japy pump, small size.

In the first class, comprising pumps of liquid direct, with compression air chamber, the Japy pumps are perhaps in as common use as any. The Japy pumps are made in two sizes, one for limited and the other for more extended work. The former (Fig. 156) consists of a reservoir with a Letestu pump and an air chamber. The pump is worked with a lever below the machine and to the lever is attached the rod that moves the agitator. The liquid is forced into the air chamber, and by the compression of the air is delivered with a constantly uniform pressure to the nozzle, which is commonly of the Riley type. The larger apparatus contains two pumps, which drive the liquid into a single reservoir; in general construction it is similar to the smaller size. Price, simple apparatus, 42 to 44 francs; compound apparatus, 55 to 58 francs.

Equally serviceable pumps of similar construction are the Vigouroux, Nogués, Perrin, and the pump of the *Société l'Avenir viticole*.

The Vigouroux pumps are made in two styles and are provided with Raveneau nozzles. Price, 45 and 48 francs.

The Nogués and Perrin pumps cost 45 and 40 francs, respectively.

The pump of the *Société l'Avenir viticole* has the reservoir either of brass, red copper, sheet iron coated with lead, or copper lined with rubber. The latter form is an invention which may prove to

be of considerable value as a means of protecting the metal from the action of corrosive liquids. The prices of these machines range from 45 to 47 francs.

The second class of pumps, or what I have termea air pumps, are less strong than the liquid pumps and need to be most carefully constructed to do good work. It is very essential that all the fittings be air tight. Not being in contact with the liquid, these pumps are less subject to injury from oxidation than are pumps of liquid direct. In general, their construction is similar to the pumps of liquid direct. The air pump is usually inclosed within the reservoir for the liquid and the air is made to escape at the bottom of the liquid so that by its upward passage it plays the rôle of an agitator. The compression of the air in the reservoir forces the liquid through the nozzle.

The Albrand apparatus, known as the rénovateur (Fig. 157), is one of the best instruments of this class. It is composed of a cylindrical reservoir of polished red copper, made absolutely air-tight. The aperture for filling is closed by a screw cap with a rubber joint. The attachment of the pump and method of working the piston are sufficiently well indicated in the figure. The pump communicates with the reservoir by a tube which reaches to the bottom of the reservoir, where it is perforated by a few holes. A delivery tube, with a stopcock, carries the liquid from the bottom of the reservoir to the nozzle. In operating the machine the air is forced into the bottom of the reservoir and, passing upward through the liquid, keeps the latter thoroughly mixed. On turning the stopcock, the liquid is forced out by the compression of the air within the reservoir. This machine is fitted either with the Albrand modification of the Riley, or with the Raveneau, nozzle. The price of the apparatus is 60 francs.

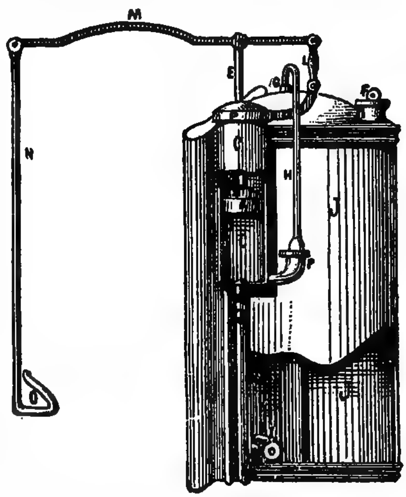

FIG. 157.—The rénovateur of Albrand. (From Viala et Ferrouillat.)

Additional pumps of this class are the Broquet, Loumaigne, and the Gaillot air pump. In the Broquet apparatus the lever or handle is beneath and the tube through which the air is forced into the reservoir does not extend to the bottom of the liquid, so that the agitation of the latter is accomplished only by the jarring induced by the movements of the operator. The Loumaigne and the Gaillot air-pumps are similar to the Albrand.

The diaphragm pumps, forming the third group, are represented by two devices: one a pump of liquid direct, the Vermorel, and the other working by air-pressure, the Noël. In general, they are not unlike the machines already alluded to, the distinctive feature being the absence of a piston; in place of which is a circular rubber plate or diaphragm which is made concave or convex by the action of a lever, and thus regulates the suction or expulsion of the liquids in the reservoir.

The Vermorel apparatus "l'Éclair" is widely used, and has a high reputation in France. It is shown in section at Fig. 158.

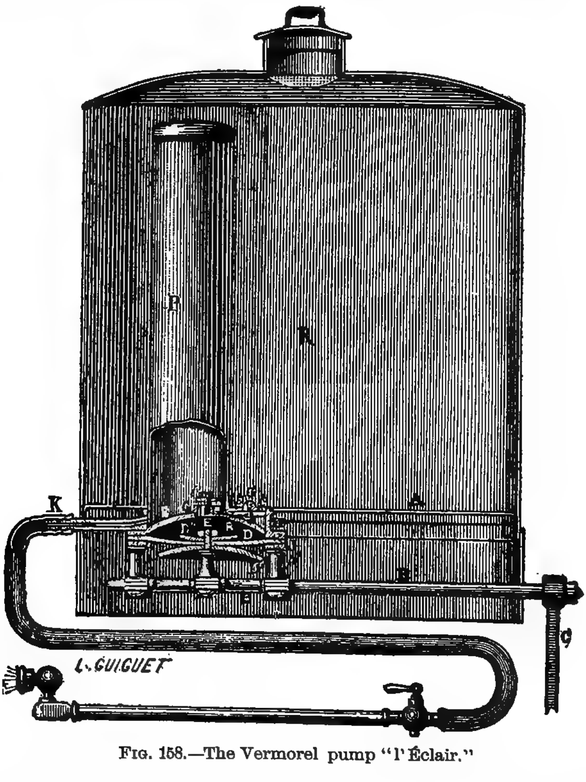

FIG. 158.—The Vermorel pump "l'Éclair."

The reservoir is either of red copper or sheet lead, and will contain 12 to 15 liters of liquid. The diaphragm or bellows pump is attached at the bottom, and above it is an air chamber P, into which the liquid is forced, thus insuring a continuous delivery. On operating the lever C the liquid passes, through suitable valves, from the reservoir into the bellows and then to the air-chamber P, from whence it is forced in a continuous stream through the tube K. The price of the machine is 40 francs.

The pump of the Noël machine is similar in principle. It is an air pump, however, and is placed at the bottom of the reservoir. It

consists of a rubber plate fastened to the concave base of the reservoir. To the center of this plate is attached the lever, and by the action of the latter the plate is raised and lowered and the air above the plate compressed and forced into the reservoir through the curved tube shown in the figure (See Fig. 64). The escape of the air at the base of the reservoir answers the purpose of an agitator. The nozzle is the Noël modification of the Riley type. The price of the apparatus is about 60 francs.

The final class of machines for spraying to which attention will be drawn is that in which the pump is entirely separate from the reservoir, being connected with the latter by a rubber hose. These pumps are in general harder to work and less effective than the other forms described in which the pump is solidly fixed to the reservoir. However, in certain localities, particularly in the Bordelais district, the syringe pumps are very well thought of by the vineyardists.

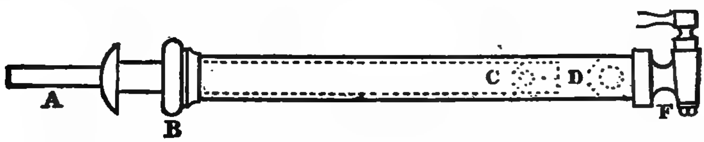

FIG. 159.—The syringe pump of the Gretillat apparatus. (From Viala et Ferrouillat.)

As a type of these pumps the Gretillat apparatus, called the "Rapid," may be noted. The knapsack reservoir will contain about 12 liters, and is connected by means of a rubber tube with the syringe pump shown at Fig. 159. The nozzle (Fig. 160) is of the colliding-jet type and may be adjusted by turning the stopcock to deliver a single stream, to free it of any solid body. This apparatus has been employed widely and successfully in Bordelais for several years. Its price is 30 francs with copper reservoir, or 26 francs with zinc reservoir. Other machines of this class are manufactured by Japy Frères, Bourdil, Vermorel, and others.

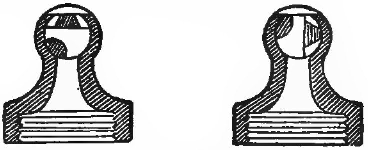
FIG. 160.—The Gretillat nozzle. (From Viala et Ferrouillat.)

It will be observed that the knapsack pumps range in capacity from 12 to 15 liters, the latter amount being about the limit that can be easily carried by a workman. Of the different materials of which the reservoirs are constructed, the red copper is very resistant and is not generally altered by contact with cupric mixtures; brass is less durable, but may be used without injury with the Bordeaux mixture.

For Eau Celeste, and even the sulphate of copper, the reservoir should be of red copper or of brass covered with lead.

If the rubber lining proves satisfactory it may be used with advantage in connection with the acid solutions of sulphate of iron in

the winter treatment of anthracnose, since the red copper even is affected by this solution.

The nozzles are commonly of copper and also of hardened caoutchouc, the latter being especially of service in spraying the acid sulphate of iron. Metal nozzles are rapidly acted on by this substance and ruined.

PART III.—WINE-MAKING.

By C. L. MARLATT.

GENERAL CONSIDERATIONS.

The manufacture of wines has an importance in France which it attains nowhere else, and the true Frenchman is as jealous of the reputation of the grand wines of Bordeaux, Bourgogne, and Champagne as he is of "La belle France" herself. The study of the processes and methods of wine-making has been prosecuted by the intelligent vineyardists of France for centuries, and the literature of the subject has grown to enormous proportions.

The Frenchman is fond of his native wines and neglects no opportunity to improve them or to extol their supreme merits and excellencies, and as a matter of fact he is supported in this last by the judgment of the world. That cheap and comparatively inferior wines—second and third wines, raisin wines, etc., and the poorer wines of certain sections—are also produced is admitted, and when these are disposed of under their true character, as the law compels in France, no objection can be raised.

The adulteration of wines by unscrupulous wine merchants and middlemen in this country as well as in France, or the disposal of inferior wines, second wines, or raisin wines under false labels, is nowhere deplored more than in France by those who have the reputation of the vine industry of the country at heart, and the French Government has passed stringent regulations to prevent falsification of wine within her borders for the protection, at least, of home consumers.*

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*FALSIFICATION OF WINES IN FRANCE.

REPORT BY CONSUL DUFAIS, OF HAVRE.

[Consular Reports, August, 1889, No. 107.]

The official journal of the French Government, of the 15th instant, promulgates a new and important law on the falsification of wines, of which I have the honor to forward herewith a translation.

F. F. DUFAIS, *Consul.*

UNITED STATES CONSULATE,
Havre, August 20, 1889.

LAW OF THE 14TH OF AUGUST, 1889, REGARDING WINES.

The Senate and Chamber of Deputies having adopted, the President of the Republic promulgates the following law :

The student of œnology and particularly the ambitious American grape-grower will, therefore, naturally turn to France and examine her methods if he wishes to familiarize himself with the secrets of an art which though old doubtless as man himself, is yet being added to and improved with every year's experience and becoming more and more subject to laws and rules rather than to experiment and trial.

Formerly wine-making was merely an art, and skill in it, together with its secrets, was handed down from father to son; now it has become more of a science than an art, and any one may familiarize

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ARTICLE 1. No one can send forth, sell, or offer to sell under the denomination of wine any other product except that made by fermentation from fresh grapes.

ART. 2. A mixture of the product by fermentation of the residue (*marc*) of fresh grapes with an addition of sugar and water with wine, no matter in what proportion, can only be sold, sent forth, or offered for sale under the name of "Wine of sugar" (*vin de sucre*).

ART. 3. The product of the fermentation of dried raisins with water can only be sent forth, sold, or offered for sale, under the name of "Wine of dried raisins;" it is the same with the mixture of such product with wine, no matter in what proportion.

ART. 4. The casks or other receptacles containing wine of sugar or wine of dried raisins must be marked in large letters "Wine of sugar," "Wine of dried raisins." Books, invoices, waybills, bills of lading, have to give the same designations according to the character of the product.

ART. 5. The bills of circulation accompanying the forwarding or shipment of such wine, wine of sugar, wine of dried raisins, must be of a special color. A ministerial degree will regulate the application of these provisions.

ART. 6. In case of infraction of the above articles the delinquents will be punished with a fine of from 25 to 500 francs, and with imprisonment of from ten days to three months. Article 463 of the penal code will be applicable. In cases of repeated delinquencies the sentence of imprisonment will always be pronounced. Tribunals may, according to the gravity of the cases, order the publishing in newspapers or by bill poster in stated places of such sentences at the expense of the delinquent.

ART. 7. Any admixture to wine, wine of sugar, wine of dried raisins, be it at the time of fermentation or afterwards, of the product either by fermentation or distillation of figs, carob bean (or St. John's bread), flower of mowra, bell flower, rice, barley or other saccharine matter, constitutes falsification of alimentary commodities provided for by law of the 27th of March, 1851.

The provisions of this law are applicable to those who falsify, hold, sell, or offer to sell alimentary produce knowing that it is falsified. Such fraudulent alimentary produce is confiscated according to article 5 of the said law. The present law, discussed and adopted by the Senate and the Chamber of Deputies, will be enforced as the law of the State.

Done at Paris, August 14, 1889.

CARNOT, *President of the Republic.*

The Minister of the Interior,
CONSTANS.

The Minister of Finances,
ROUVIER.

himself with the many steps of the process deduced both from traditional experience and later scientific researches.

The details of the manufacture of wines as recounted in the following pages are necessarily incomplete, but it is hoped that enough is said to give an intelligent appreciation of the fundamental facts and laws, and to enable those interested to compare their own methods with those practiced in France, and adopt such of the latter as are of value or applicable to the conditions of wine-making in the United States. It has been deemed best to describe the entire process of wine-making, and while various steps and methods will necessarily be detailed with which our progressive vineyardists are already familiar, it is believed that much, also, of value to our wine-makers, has by this means been included.

The writer has had access to a large number of the principal French works on wine-making, as well as the leading journals of France devoted to viticulture and vinification, and also the notes of Prof. C. V. Riley resulting from his personal examinations of the methods followed in the celebrated vineyards of central and western France and particularly the Gironde district.

In such a summary treatment of the subject it has been deemed inadvisable to repeatedly note in the text the many authorities consulted. The principal sources of information are mentioned elsewhere. (See p. 31).

The distinct steps in wine-making are: (1) the gathering of the grapes; (2) fermentation; (3) the drawing off of the wine and pressing (*cuvaison*), and (4) the correction and treatment of the crude product necessary to make a perfect wine.

In addition to these must be understood the influence of climate, soil, culture, variety of grape and maturity at gathering, on the nature of the wine. These last will be first briefly considered.

Climate.—In a warm climate such as that of the Midi or Mediterranean regions of France, which includes the lower valley of the Rhône and the borders of the Mediterranean, particularly between Hyères and Vintimille, the grape grows vigorously and produces in the berry a large percentage of sugar. The wine product is, however, lacking in acidity and bouquet and comprises principally the common wines, wines coarse and highly colored, and sweet or strongly alcoholic. Special treatment is necessary to establish a proper equilibrium between the different elements of these wines.

As one approaches the northern limits of the grape regions of France, the proportion of sugar decreases and the acid principles of the grape augment, and in the extreme north, where the grape frequently fails to properly mature, the acid elements (tartaric, tannic, and malic) greatly predominate. The bouquet is also highly developed on account of the low temperature at which fermentation takes place.

Soil.—The influence exerted by the soil is less on the character of the wine than it is on the amount of grapes produced. Wines of equal merit are produced on soils of widely differing composition. On very rich soils, however, the wine product, while abundant in quantity lacks in quality; and, on the other hand, poor soils yield the most highly prized wines, and hence it is that soils not capable of other culture are commonly planted to vines.

Other features of soil and subsoil have been dwelt upon by Prof. Riley in the consideration of vine culture.

Cultural Methods.—The methods of culture adopted with a view to improve and perfect the wine product will depend on the particular conditions of the soil and climate, and on the variety of grape grown. Thorough cultivation favors the ripening of the grape and augments the proportion of sugar in the must.

The practice of summer or green pruning has also been followed from time immemorial in many vineyards to hasten or otherwise influence the ripening and to give to the berry a normal composition, and while this practice has the sanction of long traditional experience, certain recent experiments have indicated from an analysis of the must from pruned and unpruned vines that the percentage of sugar and acidity and the density of the must is considerably lessened and the coloration also is less intense in the case of the pruned vines. The loss of foliage, from which the grapes derive their saccharine strength, would lead one to expect a result similar to the above, and in the limited experiments made the maturation was not hastened but retarded, so that the chief object of the green pruning was not accomplished. This indicates that green pruning should only be practiced, if at all, to accomplish some definite change in the composition of the must, which careful experiment has shown will result from such treatment.

Variety of Grape.—The nature of the wine, depends, of course, largely on the variety of grape grown,—the soil, climate, etc., while exerting considerable influence on the product, are important chiefly in determining what variety shall be grown. In general the early ripening sorts are grown in the north, producing wine of fine quality; and in the south later and more prolific, but inferior sorts.

The vineyards contain either a single or several varieties; in the latter case it is a frequent custom to mix the grapes in wine-making.

Many of the famous French wines are obtained from a single variety or sometimes a combination of two, rarely three, varieties. The mixing of different varieties is frequently desirable to obtain a must of proper composition. M. Rugier mentions the following grapes as those commonly grown in the different wine districts of France:

Bourgogne, *Pineau;* Beaujolais, *Gamay;* Hermitage and surrounding regions, *Petite Syrah,* associated with a white grape in the

proportion of about one-fifth, the latter being either the *Vionnier, Marsanne,* or the *Roussanne;* Bordeaux, *Cabernet-Sauvignon* in the proportion of two-fifths, the remaining third being the *Malbec, Merlot,* or the *Verdot.* In South France the *Aramon* is the prevailing variety and is associated in the proportion of about one-third with *Petit-Bouschet* or the *Alicante-Bouschet.* In the same region the *Carignan* and *Grenache* are employed to correct the excess of sugar and resulting alcohol in the varieties first named.

Fig. 161.—The Baumé must scale. (From Portes et Ruyssen.)

It will be seen from the above that in the more advanced viticultural departments of France the number of varieties grown is comparatively limited.

GRAPE GATHERING.—Of the various steps in wine-making grape gathering is chronologically the first and is also the most important. The quality of the wine—its keeping power, its composition and its distinctive aroma and bouquet—is more dependent on the condition of the grape as to maturity, and the precautions in gathering, than on any or all the subsequent steps in vinification.

Maturity of the Grape.—The period at which to gather the grape can only be determined by careful examination and experiment and will vary with different varieties, and under diverse conditions of climate and soil. The determination of the proper maturity of the grape is one of the most important steps in successful wine-making. Picked too soon, there is an excess of acids and a corresponding lack in sugar, while the richness in sugar may be increased by late picking.

In general the grapes are gathered when nourishment from the vine ceases. This condition is characterized by the brownish color of the base of the stem, the softening of the berry and its easy separation from the stem, and the translucent appearance of the skin. The juice, also, has lost its astringency and has become soft and sweet and somewhat sticky.

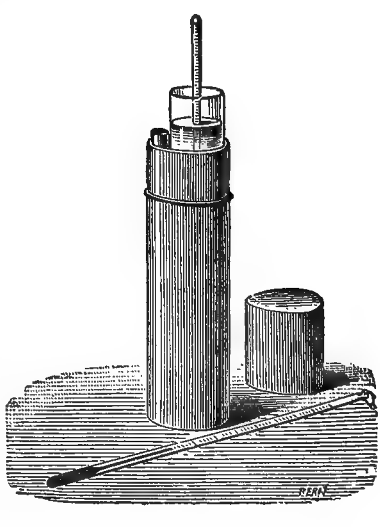


Fig. 162—The Gay-Lussac must scale manufactured by Salleron. (From Rougier.)

To determine with greater precision the best time for gathering, various instruments have been invented by the aid of which the proportion of sugar or acids in the must can be accurately estimated. The saccharometer or must scale in most common use and the oldest is the Baumé, a figure of which is given (Fig.

161). It consists of a closed graduated tube containing in the lower portion of the enlarged part mercury or lead, and this form of construction is followed in all other instruments of this class. The graduation of the Baumé instrument is altogether arbitrary, but by indicating the density of the must as compared with that of water it is possible to determine the degree of maturity of the must and to calculate the amount of alcohol that will result from its fermentation. The must will vary from 6° to 15°, the best wine being made from must indicating from 8° to 15°.

The must scale of Gay-Lussac, manufactured by M. J. Salleron, gives the density of the liquid direct, the density of water being indicated by the 0 mark, and by means of a table it is possible to approximate very closely the quantity of sugar contained in the must. This instrument is shown at Fig. 162.

The following table is shortened from one prepared by M. J. Salleron to accompany his apparatus and explains itself:

Table employed with the Salleron (Gay-Lussac) must meter.

Density or degrees of the must meter.	Corresponding degrees of the Baumé must meter.	Grams of sugar per liter of must.	Alcohol in wine made from the must.	Crystallized sugar to be added to make a wine of 10 per cent alcohol.	Water to be added per liter of must to reduce the density to 1,075° (10° Baumé).
		Kilos.	*Per cent.*	*Kilos.*	*Liter.*
1,050	6.9	0.103	6	0.068	......
1,055	7.5	.116	6.8	.054	......
1,060	8.1	.130	7.6	.041	......
1,065	8.8	.143	8.4	.027	......
1,070	9.4	.156	9.2	.013	......
1,075	10	.170	10	......	......
1,080	10.7	.183	10.8	......	0.06
1,085	11.3	.196	11.5	......	.13
1,090	11.9	.210	12.3	......	.20
1,095	12.5	.223	13.1	......	.26
1,100	13.1	.236	13.9	......	.33

The correction of the must by the application of water or sugar, as indicated in columns 6 and 5, will be considered later on.

A third and very convenient must scale may be mentioned, viz, that of Jules Guyot. This instrument indicates at once, by means of three graduated columns on the stem, the degrees Baumé, the quantity of sugar contained in the must per hectoliter, and the amount of alcohol that will be produced per hectoliter.

This must scale, on account of the facility of its use and the multiplicity of the formation gained at once, is highly appreciated by the French wine-makers.

To determine the sugar content of the grapes a few bunches are gathered, representing as near as possible the average condition of the crop, and the juice is expressed and strained through linen or cotton cloth, collected in a suitable vessel, commonly of glass, and

the must meter plunged into it. The quality of the must will then be indicated on the stem of the must meter.

The grapes are tested from day to day until the density remains stationary, when it is time, generally speaking, to gather the crop.

The must meter is not only of service in determining the richness in sugar of the grape juice, but is also employed to measure the fermentation and to determine when the sugar contained in the must has been entirely transformed into alcohol, as will be shown later.

The general rule to gather the crop when complete maturity is reached has exceptions. In south France it is frequently found advisable to gather the crop before maturity to augment the amount of acid, which is generally lacking in grapes grown in that region, or if the variety ripens at different periods the crop is commonly gathered when one-half the fruit is well ripened. If the grapes become overripe before gathered it is the custom to correct the composition of the must by adding a certain proportion of some variety yet partly green. The presence of the under-ripe fruit causes in the freshly pressed wine a slightly disagreeable flavor, which, however, corrects itself and disappears with the aging of the wine. Without these precautions the wines of the Midi are poor in bouquet and body and deteriorate rapidly.

The character of the wine which it is desired to produce or the variety of grape also act to determine the degree of maturity at which to gather the crop. Thus certain varieties, as the Muscat and the Malvoisie, are allowed to become over ripe to develop the characteristic aroma of the wines produced from them; and in the case of American varieties having a foxy flavor this objectionable feature is diminished by early gathering.

Time.—When it is possible to choose the most favorable time, gathering in the temperate regions is done after a succession of fair days and in the morning as soon as the dew has disappeared. A moderate degree of warmth also facilitates and hastens fermentation. In the very hot regions of southern France cloudy weather is preferable if rain does not fall, as moisture of rain or dew on the berries greatly prejudices the wine. In excessively hot countries, as in Algiers, it is recommended to gather the grapes early in the morning or late in the evening or at night, or at least to allow them to stand and cool over night before putting them into the fermentation casks.

The objectionable effect of the presence of dew on the grapes is stated to be not so much from the introduction of a certain amount of water, but in part from the introduction of germs floating in the atmosphere prejudicial to the wine, but chiefly because the grapes are too cold to enter readily into fermentation.

Instruments and Methods.—The instruments employed to detach the bunches are the curved knife used in pruning the vines, the ordinary pocket-knife, and small shears. The latter are considered

much preferable and are rapidly gaining in popularity. The use of the knife is objectionable because of its jarring the bunch and frequently causing more or less of the berries to fall off.

The grapes as gathered (and this work is commonly done by women and children) are collected in tin or wooden vessels of various forms, and in choice wine districts the greatest precautions as to cleansing of the utensils is taken, together with the apparatus used in the subsequent crushing and pressing of the grapes, to prevent the introduction of any foreign taste of wood or mold, etc.

The tin pails (Fig. 163) are preferred because they will retain the juice, which never fails to escape when the grapes are allowed to fall from any height, or when the vessel is overfilled.

The grape gatherers empty their vessels into large wooden tubs or receiving vats (Fig. 165), having a capacity of from 20 to 80 kilograms, and constructed in a variety of styles.

A grape-gathering force consists of the cutters or gatherers proper and the carriers. The latter receive the grapes in the larger vessels

FIG. 163.—Pail used in gathering grapes. (From Rougier.)

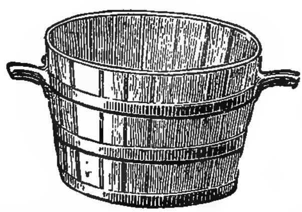


FIG. 164.—Receiving or carrying tub used in grape-gathering. (From Rougier.)

named, and sort them and transport them to the carts. They also oversee and direct the work of the cutters. In Bourgogne one carrier suffices for five cutters. In south France, where the yield is more abundant, the number of cutters to one carrier is reduced to three or four. In south France, also, the grapes are frequently emptied by the cutters directly into special carts.

In vineyards noted for their fine wines the sorting of the grapes is done with the utmost care as they are gathered either in the vineyard or at the cellar. In the former case the gatherers have special vessels to receive the injured, diseased, or unripe berries, or those soiled with earth or sulphur.

It was formerly more frequently the case than at present to gather the grapes at successive periods as they ripened. This method is now chiefly restricted to those noted vineyards which produce wines of such value that it is advisable to take every precaution in gathering and subsequent treatment to develop the special qualities of their wine products. Thus at Bordeaux the system of gathering is more complicated, and the maturity of the grapes at gathering varies

greatly in the production of the celebrated red and white wines of this region.

To obtain the rich, mellow, almost oily characteristics of the famous white wines of Sauterne not only are six or seven distinct gatherings made, but the grapes must be more than completely ripe, and in fact so dried by the action of the sun that almost one-half of their watery contents has been dissipated. The producers of the best wines of Champagne, Médoc, and Bourgogne use similar precautions, all of which is quite the opposite of the wholesale and somewhat careless methods of the Midi in the production of ordinary and cheap wines.

WINE MAKING PROPER.

THE CELLAR AND FURNITURE.—The building in which the must is fermented and the wine made is termed in France, as also in this country, a cellar. It is also commonly called a *cuverie*, from *cuve*, a vat or tub. As temperature has an important bearing on the fermentation of the must, it is the important feature taken into account in the location and construction of the cellar. Effort is made to control the interior temperature and also protect the building from the changing temperature of the outer air.

In the Mediterranean region, and also elsewhere in France, the cellar is commonly constructed on a hillside in such manner that one side is in part embedded in and protected by the soil. This arrangement allows the grape carts to be taken directly into the upper or press room of the cuverie. The building is still further protected from exterior heat by attached sheds and also by planting rows of trees about it. The use of double-storied buildings also greatly assists in the control of the temperature. In these the grapes are unloaded in the upper story and introduced through traps into the tuns or vats in the basement story. The control over the temperature is still further increased by constructing the buildings with double walls and by introducing the air for ventilation through flues opening at or below the surface of the ground. The dimensions of the cuverie vary with the extent of the vineyard and the size of the casks employed. It is usually made three or four times as long as wide. The height of the lower room is that of the wine casks or tuns augmented by about one meter. The casks are commonly elevated 75 centimeters on supports, which would leave a space of 25 centimeters between them and the ceiling.

In the less heated regions of France, including the southwest, center, and east, it is frequently necessary to protect the wine cellars from too low temperature rather than too high. The same means are employed, viz, double walls, exterior protection, etc., and the openings are confined to the southern facade of the building.

In certain regions, particularly in south France, where the quan-

tity of the wine manufactured is of more importance than its quality, the cuverie is less carefully planned as to temperature regulation, and is more cheaply constructed, and consists commonly of a one-story, rectangular building of sufficient width to contain two rows of vats or tuns, with an alley space along the center to serve as a passageway for the grape carts. These structures are only employed in the manufacture of inferior wines, since being subject to the direct action of the sun and the hot air, the high temperature resulting within the building destroys much of the finer qualities of the grape.

The cellar furniture comprises the press, mills for washing and preparing the grapes, fermentation vats, casks or tuns, tubs used in pressing, the saccharometer or must scale, etc. These will be considered more in detail in the discussion of the several steps in wine making.

CUVAGE, OR FERMENTATION OF THE GRAPE ON THE HUSKS.—The term cuvage means the fermentation of the grape juice or must in connection with the skins or husks and other solid parts of the berry, and hence does not apply to the manufacture of white wines, in which the must is separated from the solid parts immediately after gathering. The making of white and other special wines will be treated after describing the methods employed in making the more important red wines.

The preparation of the grapes for fermentation in the manufacture of red wines includes a number of operations, all of which may sometimes be omitted. Thus the grapes may be thrown at once into the fermenting vats, or they may be more or less crushed, or, finally, the berries may be entirely separated from the stems and crushed before placing them in the vats.

The special treatments referred to are foulage, or crushing or mashing the grapes, and égrappage, or stemming or separating the berries from the stems.

Stemming.—Égrappage or stemming has been followed more or less from the earliest times, but is far from being generally practiced by French wine-makers. The stem when introduced with the must acts on the latter mechanically and chemically. The mechanical action consists in facilitating the access of air, and consequently the fermentation.

The chemical action arises from the stems imparting to the wine a considerable portion of the tannic acid which they contain and thus giving the wine a certain astringency which is of value to the wines of south France, which frequently lack in acidity, and is an objection to wines which are naturally acid or strong in tannic acid.

The variety of grape and the state of maturity of the crop are taken into account in deciding whether to practice égrappage or not. The proper course can only be determined by experience or by an analysis of the grapes in each region and for each variety of grape.

The following rules for égrappage are given by Rougier (Manuel Pratique de Vinification, p. 48):

In general the stems should be removed (1) when the grapes are very green; (2) when the variety is naturally very astringent.

The stems should be retained (1) when the maturity is much advanced; (2) when the grapes lack acidity, and when they contain a considerable quantity of mucilaginous matters, as in the case of those grown on very rich lands. The stems should also be retained whenever there is liability of incomplete fermentation.

The instruments designed to separate the berry from the stem are numerous and varied. For small quantities of grapes égrappage is accomplished by means of a trident, as follows:

Into a tub partially filled with grapes the operator plunges a three-branched rod or trident, which he causes to revolve rapidly. The berries are by this means detached and go to the bottom, while the lighter stems rise to the surface and are removed.

Another method followed for limited work is the use of an osier sieve with meshes sufficiently large to allow the passage of the berries and at the same time to retain the stems. The sieve or screen is placed above the vat or above the hopper of the crusher and partially filled with grapes, and by shaking it backward and forward the berries are separated and fall into the vat.

For larger quantities of grapes recourse is had either to the égrappoir or stemmer of Loyère & Gaillot or to the much more effective and superior rotating égrappoir recently devised and perfected by M. Gaillot. The latter only will be described. It consists of two instruments united into one; (1) a crushing mill placed on the upper part, which is provided with two cylinders, between which the grapes are passed; (2) the égrappoir proper, which is composed of a kind of box having for its base a semi-cylindrical sheet of copper pierced with holes of 30 milimeters diameter. In this box is a shaft provided with lateral arms arranged in the form of a helix. The grapes are emptied into the hopper, are crushed in passing between the rollers, and fall into the égrappoir. The movement of rotation frees the stems from the berries and juice, which escapes through the copper bottom, and the stems by means of the lateral arms, are carried to the extremity of the instrument where they are discharged. The work goes on continuously, one man being sufficient to operate the machine. From 70 to 80 kilograms of grapes are discharged per minute. If desired the crusher can be employed separately, it being possible to easily detach it from the égrappoir proper.

After passing from the cylinder the stems still retain a small quantity of must, which is extracted by pressing and is generally kept separate and employed in making vinegar. A mounted machine of this kind is shown at Fig. 165.

Crushing.—The crushing of the grape, or foulage, which consists

in rupturing the skin and expressing a considerable portion of the juice, when deemed advisable, is done either before or while the grapes are being placed in the fermentation vats. Foulage is ordinarily considered indispensable to the complete fermentation of the juice of the grape, but under certain circumstances it may be partly or entirely omitted and it has been found that the best wines of Bordeaux in years when the grapes reach their full maturity are made without foulage, and while being lighter colored, are distinctly finer in taste. Rougier, in the work already quoted, gives the following rules for foulage: (1) Complete foulage is useless in South France for thin skinned grapes which are fermented in casks. The partial crushing given them in placing them in the casks is sufficient. (2) Placing grapes in casks and crushing them after fermentation begins may be favorable in the case of incompletely ripened fruit.

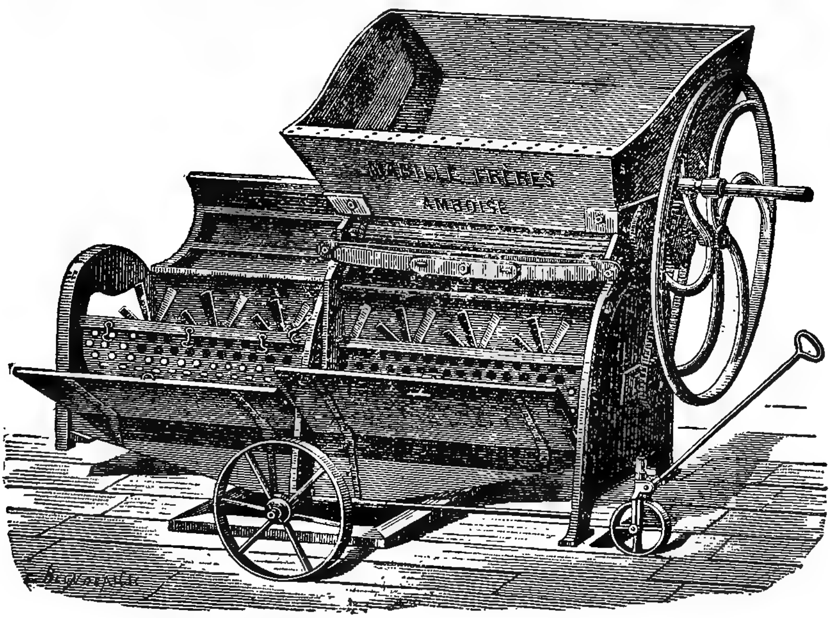


FIG. 165.—Mounted rotating égrappoir (Gaillot system). Mabille freres, Amboise. France.

(3) In all other cases crushing probably ought to be practiced. (4) If crushing is practiced before the grapes are placed in the fermentation vats it is necessary for each locality and for each variety of grape to determine by experiment whether the crushing should be complete or partial.

Foulage is accomplished in various ways, including the traditional method with human feet, which last, while somewhat repugnant, is claimed to have certain real advantages. The weight of a man or woman is not apt to crush any green grapes that may occur, and especially the seeds, which it is very important to leave intact, as

they contain an oil injurious to the wine. The trituration of the skins is also better accomplished.

The foot method consists in tramping the grapes either with the naked feet or with wooden shoes—the former preferred—on special platforms, from which the liquid runs as fast as it is expressed. The operation is long and tedious and has, in a measure, been supplanted by the employment of machine crushers.

There are numerous makes of mechanical crushers used throughout France, but they are generally constructed after the same type, being practically identical with the form referred to in connection with the crushing égrappoir of Gaillot. They consist of a hopper beneath which work two grooved cylinders. The latter may be regulated as to distance of separation so that the crushing may be of any desired degree of completeness. The hollow cast-iron cylinders

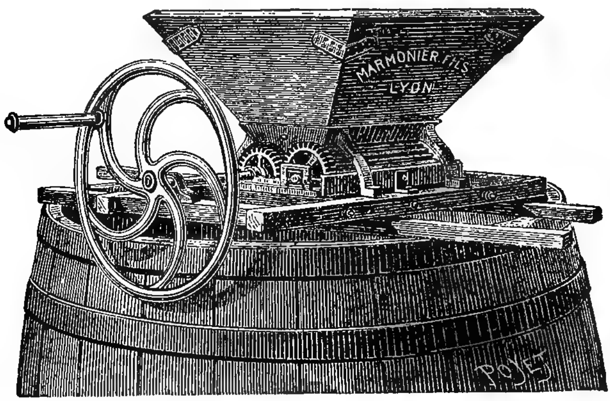


FIG. 166.—Simple grape-crusher. Marmonnier fils, Lyons, France.

now commonly used are preferable to wooden ones, the latter being apt to swell and warp or to be injured by the small stones or bits of wood that accidentally become mixed with the grapes. The crusher is frequently mounted on a simple frame so that it may readily be placed either directly above the pressing crate as in the manufacture of white wines or over the fermentation vat in the case of red wines (Fig. 166.) The grape-crushers are, however, ordinarily mounted, and the legs are frequently provided with wheels to facilitate transportation. This is always the case when the crushing is done in a room above the cellar proper, the grapes being discharged from the machine through openings in the floor into the fermentation vats below, as illustrated in Fig. 167, which represents a crusher of the form generally used in South France.

Foulage is sometimes accomplished after the grapes are placed in the fermentation vat as follows:

A man, naked of course, gets into the vat and breaks the grapes up with his body, hands, and feet, and thoroughly distributes the solid parts of the grape throughout the must. This method is not only exceedingly repugnant, but is accompanied with considerable danger to the operator by reason of the escape in large quantities of carbonic acid gas during fermentation. To avoid this danger the cellars are thoroughly aired and the precaution is taken to have an assistant near at hand. Tests with a candle are also made before entering the vat.

Foulage in the vats is also done with crushing sticks or pounders consisting of a handle and an enlarged end with which the grapes are broken up and incorporated with the must. In the two methods

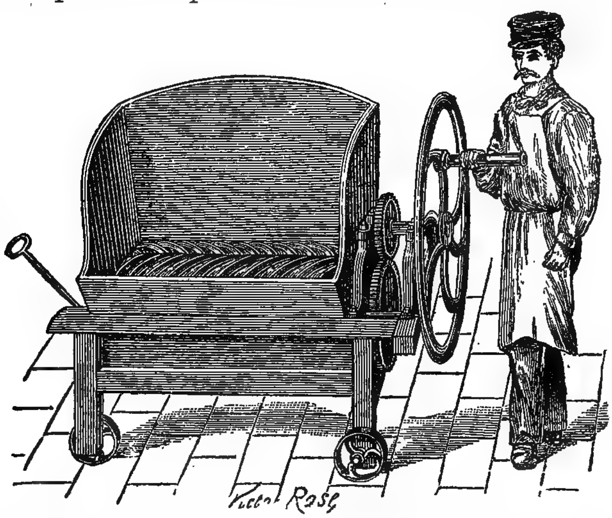


FIG. 167.—Grape-crusher used in South France. G. Pepin fils aîne, Bordeaux, France.

just described and where the human feet are employed the must is thoroughly aërated, which is not the case when the crushing is accomplished by means of the machines described above. Thorough aëration greatly facilitates fermentation and is very useful in certain cases, notably when it is desirable to obtain a complete transformation of the sugar into alcohol and to aid in the defecation or clearing of wines made from grapes too rich in nitrogenous matters. Aëration is also practiced in regions where the temperature is normally low and fermentation consequently proceeds slowly. To aërate the must suction and force pumps are sometimes employed to force the liquid must back into the general mass, which at the same time incorporates with the latter a good deal of air.

A machine for crushing the grapes and aërating them at the same time has been invented by Dr. Menudier and has given good success,

particularly in the making of white wines. The machine consists of a frame on which is mounted an iron cylinder (Fig. 168). The latter is the essential feature of the apparatus and is pierced by a shaft moved by a system of wheels and belts. The shaft bears six paddles and may be caused to revolve from 190 to 210 times per minute. The grapes are churned violently for from 15 to 40 seconds and are thoroughly broken up and aërated and a complete and rapid fermentation follows. In spite of the violence of the operation the skins and seeds, and even the stems, are rarely broken.

The cylinder can be easily filled and emptied, two men being required for this purpose.

Fermentation Vats or Cuves.—The *cuves* or vats in which the grapes are fermented are generally large tanks of oak or chestnut, having the form of truncated cones and resting on the larger base. Their capacity varies from 15 to 40 hectoliters. In the Midi of France immense cuves of masonry are constructed, the interior of which are lined with glazed bricks or more rarely with cement. In point of economy and facility in cleansing these are superior to the wooden vats. Should it be desirable to elevate the temperature of the must, however, this cannot be done so easly in the case of cuves of masonry as with wooden cuves; but this objection is obviated in part by the former retaining the heat resulting from fermentation much more completely. In cold regions therefore the cuves of masonry are excellent to maintain the temperature necessary to regular fermentation, but frequently artificial heat must be employed to start satisfactory action. In the warm regions of southern France, however, they rather add to the defects of the wines by preventing the radiation of the heat of fermentation and maintaining a too-elevated temperature. As in the case of the cuves of wood they are made either open or closed. Before being used for the first time they are washed out with a weak mixture of sulphuric or tartaric acid in water to saturate the salts of lime and to prevent the latter from abstracting the acids from the wine. The cuve is then sponged out and filled with water, which after a time is drawn off and the cuve thorougly rinsed. Cuves lined with cement are prepared for the grapes by rinsing them with a solution of silicate of potassium.

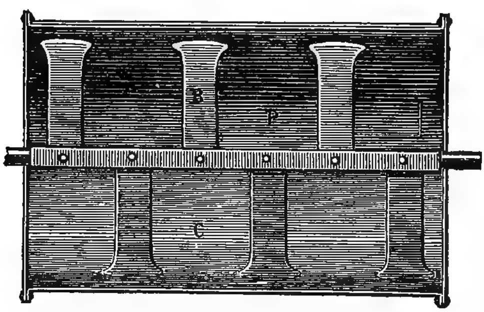


FIG. 168.—The Menudier crusher and aërator. Section of the cylinder showing shaft and paddles. (From Rougier.)

Vats of wood are especially adapted to the fermentation of wine, since, apart from certain resinous matters, they communicate no

objectionable taste to the wine. They are therefore always employed for all the finer and more valuable wines. A small quantity of air also passes through the wood and doubtless has an effect in improving the quality of the wine. A few of the many forms of wooden fermentation vats may be noticed, including the wine casks or tuns used for this purpose in South France, open casks, closed casks, and casks with stages or stories. The use, for fermentation tanks, of the smaller casks that are afterwards to contain the wine is generally followed in South France, where the great quantity, of wine produced makes it necessary to economize in methods employed. For that region and with grapes previously crushed or with very thin-skinned varieties this method gives excellent results and may be employed also in all regions where on account of high temperature the grapes ferment readily.

It is not possible to easily crush the grapes in these small casks, but in the regions where they are used this is not very essential, and if it should be necessary the grapes may be crushed and aërated before placing them in the casks.

There has been in France considerable controversy as to the respective merits of open or completely closed cuves, and the matter is still in dispute. It is admitted that while the oxygen of the air is essential to the starting of fermentation and that it accelerates the transformation of the sugar into alcohol, it will, when in contact with the alcohol contained in the chapeau or cap of husks raised by the fermentation, transform the alcohol into acetic acid and thus injure the wine. If, however, the precaution is taken to leave a sufficient space between the grapes and the top of the cask, the husks will not be raised so high but that the carbonic-acid gas, which is heavier than air, will form a protecting layer above them. The protection of the carbonic-acid gas can be depended on as long as the fermentation is rapid and tumultuous, and when the wine is drawn off immediateiy after such action, as in Beaujolais, there is no fear of injury by the formation of acids. Any inconvenience may, however, be avoided by pressing or submerging the husks beneath the liquid several times daily.

With the open casks also the grapes may be introduced without having been previously crushed, which in certain cases is desirable, as already pointed out. It is still further claimed for the open casks that the fermentation is more rapid and complete, and also that the wine is better colored, especially if the crushing and aëration of the grapes and must in the casks are repeated several times.

With closed vats there is little danger of the formation of acetic acid, since the chapeau is not in contact with the air, and when it is necessary or desirable to prolong the cuvage after active fermentation has ceased closed casks are used. The course of the fermentation is the same, but it is necessary to crush and aërate the grapes more

thoroughly before placing them in the casks, as this can not easily be done afterwards. The trap through which the grapes are introduced is raised during active fermentation, but should be closed as soon as such action stops, to prevent contact with air.

Prolonged cuvage is employed to transform the sugar completely into alcohol and to facilitate by long maceration the extraction of certain useful principles from the stems, etc., and also to develop the superior mellow flavor of fine wines. It has the inconvenience, however, to cause the loss of about one-eighth of the total quantity of alcohol in the wine, this amount being taken up by the stems of the grapes.

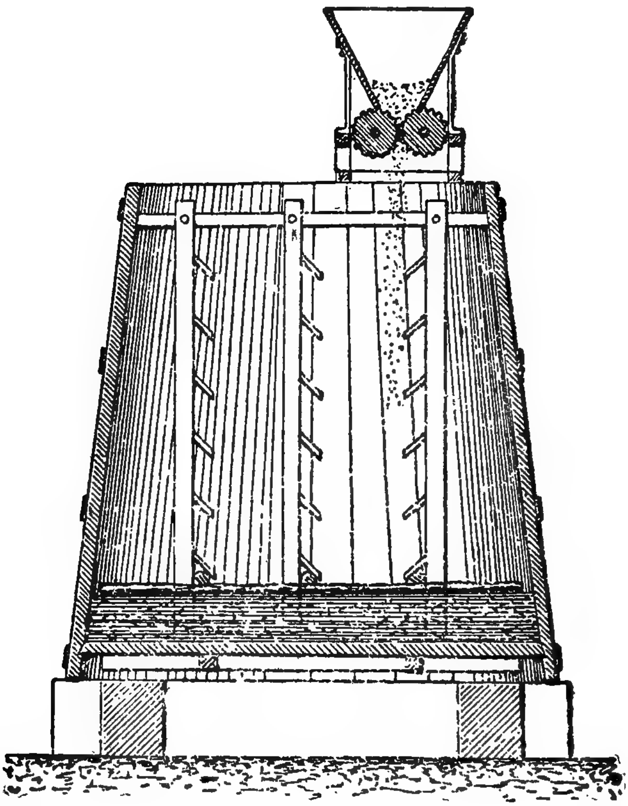


FIG. 169.—The Perret cuve. Vertical section, showing one of the transverse stages in place, and two of the vertical supports. (From Rougier.)

To avoid this loss, and at the same time to retain the advantages of closed cuvage, M. Perret has invented a cuve or cask with stages or stories by means of which the solid parts, husks, stems, etc., are held uniformly distributed throughout the liquid.

In a cask of ordinary form are fixed six vertical supports, which serve to retain in place the several stages or screens, as indicated in Fig. 169. The stages consist each of three main crosspieces and a number of smaller sticks arranged at right angles with the former,

and are put in place by means of a large opening in the top of the cask as the latter is being charged. The grapes, previously crushed, are introduced into the cask and divided into successive strata by means of the screens. A space of about 50 centimeters is left between the last screen and the top of the cask, and a little straw is placed beneath the superior screen to retain any detached grapes which might otherwise rise to the surface. By the action of the escaping gas the husks are raised and retained by each screen, and the liquid, by the inflation of the mass, soon rises and covers the entire series of screens.

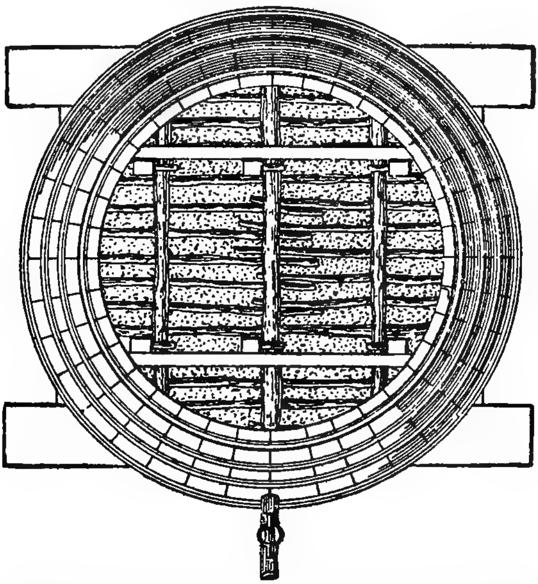


FIG. 170.—The same. Horizontal section, indicating the disposition of the sticks forming the screens. (From Rougier.)

It is claimed for this system that the distribution of the husks throughout the liquid facilitates fermentation, about six days only being required for complete action under ordinary conditions. This rapid action diminishes the amount of alcohol absorbed by the stems and at the same time, by reason of the thorough mixture of the solid parts with the liquid, the abstraction from the former of all the desirable elements is effected. The excessive formation of acetic acid is also rendered impossible.

This system of fermentation is highly recommended, and has been used successfully for twenty years in the central vine regions of France, where the richness of the must necessitates a prolonged cuvage and where the cold of winter frequently arrests the transformation of the sugar.

A system somewhat analogous to the above has been devised by M. Ferrague and used by him with good results. Its main feature

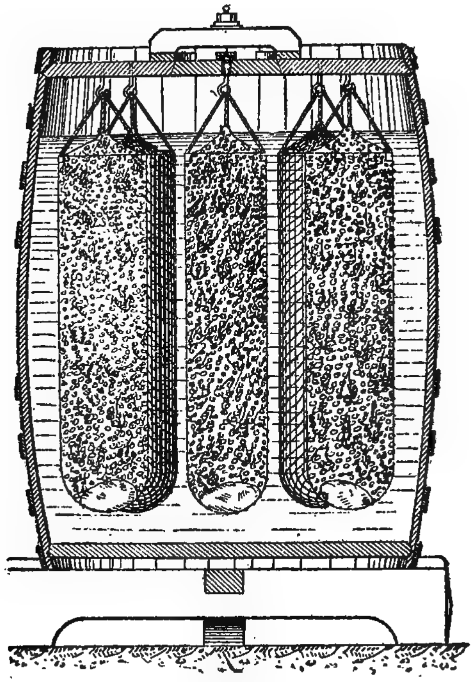


FIG. 171.—Ferrague cuve; vertical section.

consists in suspending the solid parts of the crushed grapes in the vat by means of coarse ramie-cloth bags, which may be easily removed after the wine is drawn off and obviates the necessity of

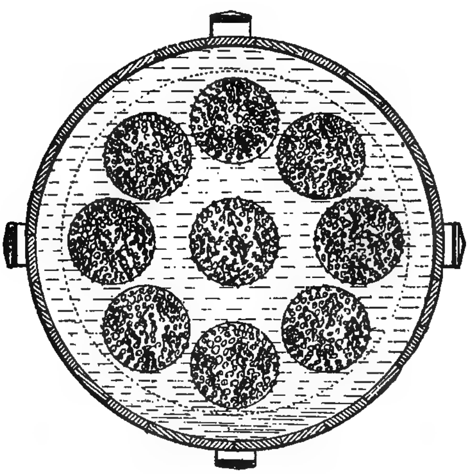


FIG. 172.—Same, horizontal section.

entering the vats to remove the residue. The details of the method are well indicated in the accompanying figures. (Figs. 171 and 172).

Relation of Temperature to Cuvage.—In the foregoing pages the influence of temperature on alcoholic fermentation has been referred to in connection with the subject of wine cellars and fermentation vats. The methods employed in France to control the temperature during the fermenting of the grapes remain to be pointed out.

The most suitable temperature seems to be between 15° and 25° C. At less than 15° the action is very slow and may be arrested altogether. Above 25° the action is too rapid and yet not complete, and flat wines without bouquet are produced.

This corresponds with the experience of American wine-makers, who have learned that temperature exerts a controlling influence on fermentation, especially in must, from late gatherings of over-ripe grapes. The must from such grapes frequently becomes what is termed "stuck," by which is meant the cessation of fermentation before the sugar is all converted. This difficulty occurs in dry, hot seasons, and with grapes having unusual saccharine strength, say exceeding 24 per cent. In Fahrenheit the temperature should be from 75° to 85°; above 100° there is danger of acetic fermentation setting in.

Stuck wines which will contain from 2 to 10 per cent of unconverted sugar are almost certain to spoil ultimately, and unless it be deemed advisable to convert them into port wines immediate steps must be taken to reinduce the action of fermentation.

One of the best preventives for this difficulty is the use of shallow vats or cuves whenever trouble is feared. These should not be more than 3 or 4 feet deep, but may be from 10 to 20 feet in diameter, and if the must be frequently stirred or the liquid pumped back into itself, excessive heating will be prevented, and the consequent aeration of the mass will greatly hasten and facilitate fermentation. To lower the temperature, also, the French, in addition to the location and arrangement of the cellar previously indicated, sometimes adopt the expedient of directing a current of air through subterranean and moist passages into the lower part of the cellar or cause cold water to circulate about the casks by means of a system of piping.

Other means consist in reducing the saccharine strength by blending the over-ripe product with grapes poorer in sugar, or as a last resort pure water may be added as soon as the grapes are crushed—5 gallons of water being found sufficient to reduce 1 ton of must 1 per cent in sugar. Watered musts, however, yield wines of inferior keeping quality, and in which acetic fermentation will set in almost as soon as opened for consumption.

The same difficulty is avoided in California by drawing off the imperfectly fermented wine and adding it to the press wine. To this liquid is added freshly crushed grapes equal in amount to the quantity of stuck wine. By thus withdrawing a large percentage of the

pomace which generates the objectionable heat and supplying fresh material for fermentation, a new action will take place and probably proceed to a successful termination.

In general the more rapid the fermentation the better, although this will vary with the climate and variety of grape. In Bordeaux the action is usually completed in from seven to ten days, but in warmer regions in four to five days. If it is too slow or too much prolonged acetic fermentation will begin at the top, particularly with a floating cap.

In cold regions, however, the reverse difficulty is experienced, and it becomes necessary to adopt means of elevating the temperature of the must to start and maintain fermentation. The commencement of fermentation is also sometimes delayed by the cooling of the picked grapes or the pomace, or, in the case of white grapes, the expressed must, over night.

To obviate this difficulty arising from these or other causes the following means are adopted:

A certain quantity of the must is heated and poured directly into the cask, care being taken not to raise the temperature above 125° F., otherwise the germs of fermentation will be destroyed; or a more simple method is to insert in the must a cylinder containing burning charcoal. Dr. Guyot advises placing in the must a U-shaped tube through which steam is caused to circulate; quartz rocks also are heated and introduced into the vats for this purpose. In the case of cuves of masonry the walls may be heated before introducing the grapes, by means of a stove placed within the cuve. Ordinarily, however, the heat can be sufficiently regulated by closing or opening the windows and entrances or by a stove in the interior of the cellar. Fresh washed yeast is also used to start fermentation but is not recommended since it is liable to give an objectionable flavor to the wine.

DECUVAGE AND PRESSURAGE, OR RACKING THE WINE AND PRESSING THE HUSKS.—The duration of fermentation depends on a variety of conditions which have already been indicated.

In general the wine should be drawn off after active fermentation has ceased and when the saccharometer indicates that the sugar has been entirely transformed into alcohol, and finally when the temperature of the wine approaches that of the surrounding air.

It will be easily seen that the duration of the cuvage has an important bearing on the character of the wine, and its action in that particular must be studied for each variety of grape and for each locality.

Completely fermented wines are more delicate because of the smaller amounts of coloring matter and acids which they contain, while wines that have remained for a long time in contact with the stems, etc., are more strongly colored and more solid.

In south France (Midi) the climate is so mild that fermentation

will continue after decuvage in the wine tuns, so that it is not essential in that region to delay decuvage until the sugar has been entirely converted into alcohol. In colder regions the transformation should be complete. If the fermentation has been incomplete a secondary action, known as *tourne* (turning), will take place in the following spring, which is attended with grave results to the wine, changing it in color from red to violet and giving it a disagreeable taste.

At the proper moment the wine is racked off or separated from the husks by means of a siphon or more generally a tap or spigot placed at the lower part of the cask. It is considered very important that the husks and lees should remain as short a time as possible in contact

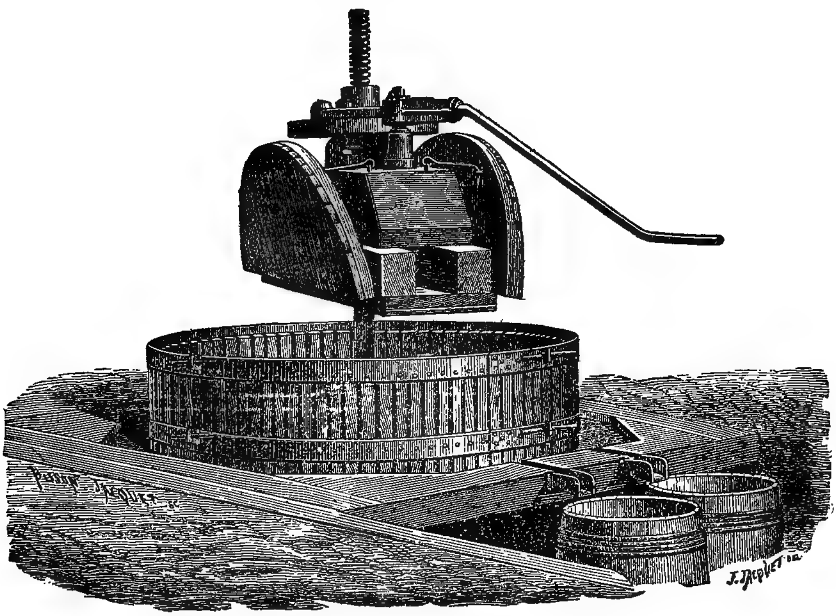


FIG. 173.—Mabille Brothers' wine-press; ordinary type.

with the air after the wine has been drawn off to prevent the formation of acetic acid.

Pressing and Presses.—The styles of wine presses are very numerous and are either stationary or mounted to facilitate their transportation from place to place. The principal variations and novelties in these have been described in connection with cider presses under class 74. A few presses especially intended for use in wine-making may here be mentioned.

Fig. 173 represents a press of the ordinary type by Mabille Brothers especially adapted for pressing grapes for champagne wines, and provided with a folding cover; it is also placed low upon the ground a space being dug away for the reception of barrels, etc., to catch the liquid as it issues from the press.

Fig. 174 represents a large press, made by the same house, and also especially for use in champagne wine districts. It rests upon a solid foundation of masonry, and is provided with a frame supported by cast-iron columns, and has a screw, worked by hand or by horse power, through the medium of a conical series of chain wheels, the pressure being rapid at first and then becoming slower and slower.

The presses described are of the common form and work interruptedly. A continuously acting press has been invented by M.

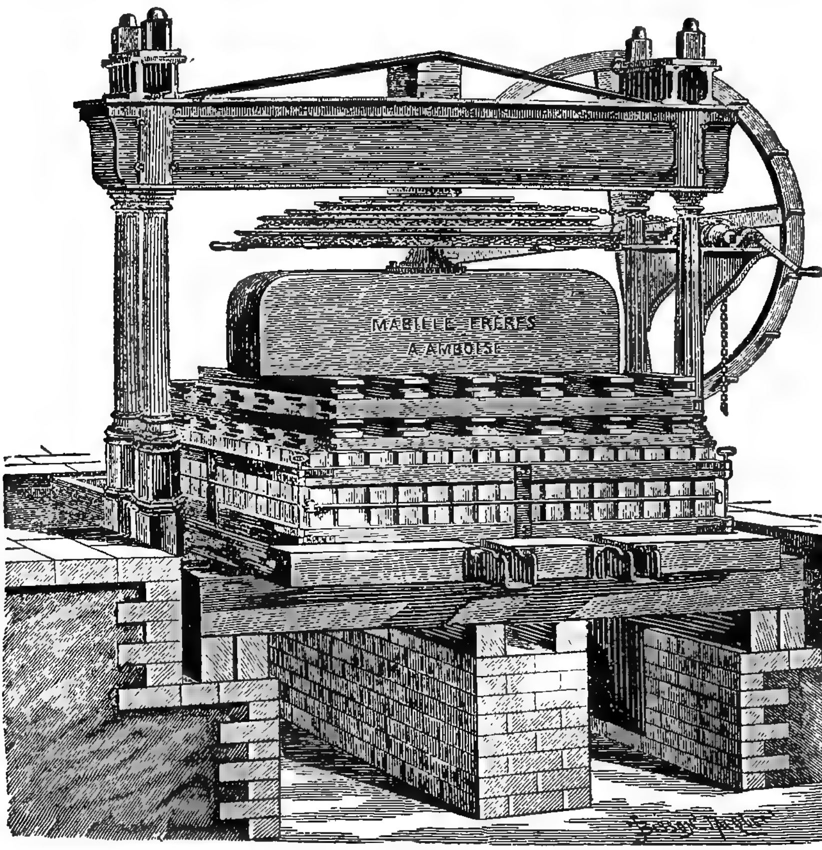


FIG. 174.—Same; large size used in the Champagne district.

Masson, of Lyons, by means of which more rapid work can be done and greater percentage of the liquid extracted. The press is composed of two cylinders, pierced with holes over their entire surface, and capable of being adjusted as to width of separation, and made to revolve in opposite directions. The husks and lees pass from the hopper onto two endless aprons and are carried by the latter between the cylinders. The wine passes through the aprons and into the interior of the cylinders through the holes in the latter, and is re-

ceived in gutters which conduct it to the discharge pipes. The aprons are freed from the husks by the action of two circular brushes which revolve in a direction opposite to the motion of the aprons.

These machines are constructed to be operated by hand, horse (Fig. 175), or steam power. From 400 to 3,000 kilograms of husks, etc., can be pressed per hour.

Press-wine and Cuve-wine.—The wine obtained by pressing the husks and lees has not the same composition as that drawn from the casks. The latter is commonly called cuve-wine and the former press-wine (*vin de cuve* and *vin de presse*). The cuve-wine is less acid and holds less solid matter in suspension. The press-wine varies greatly in composition and is generally divided into three lots. The first to run from the press is similar to the cuve-wine, containing, however, a little more alcohol, coloring matter, and acid principles.

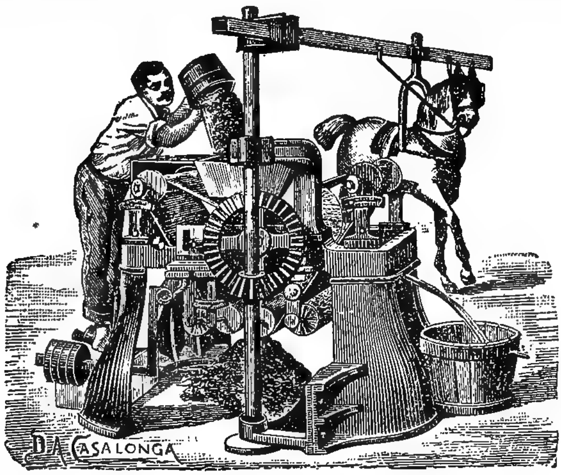


FIG. 175.—The Masson horse-power press. (From Rougier.)

The second lot contains less coloring matter and alcohol than the cuve-wine, but the proportion of acids is greatly augmented. The last of the press-wine is still more acid and astringent, and is also strongly mucilaginous and contains a considerable proportion of albuminous elements. It is seldom incorporated with the wine, but is used in the manufacture of vinegar or brandy. The first two lots are sometimes added to the cuve-wine to improve its keeping qualities. It is estimated that the cuve-wine represents three-fourths of the product and the press-wine one-fourth.

CORRECTION AND AMELIORATION OF THE VINTAGE.—In favorable years and under proper conditions the grape juice, without additions, will make perfect wine. Unfortunately this is seldom the case. Either the proportion of sugar will be too great or too little or the grapes will have to be gathered before fully matured, or they will be affected by fungous diseases, so that it becomes necessary to

correct the vintage in one or several respects. This is done by combining different varieties of grapes and by the addition of sugar, brandy or alcohol, plaster, tartaric acid, etc., and is legitimately done only to correct some natural defect in the must and not to fraudulently increase the quantity at the expense of quality. In this country the artificial correction or amelioration of the wine is frequently cried out against, although its necessity in certain cases is recognized by many leading viticulturists. In France it is practiced without question and the value of such treatment is universally recognized.

Combining different Grapes.—Reference has been made to the growth of two or more varieties of grapes in France in the same vineyard with a view of combining them to produce a suitable must. The varieties that may be suitably united and the proper proportion of each to use can only be determined by experiment and by testing with the must meter at the time of gathering.

Sugaring Wines.—Knowing that a wine should contain from 6 to 8 per cent of alcohol to pass through the summer without alteration, and from 9 to 12 per cent for long preservation either in casks or bottles, the amount of sugar necessary to be added to make up the deficiency in the must can readily be determined by testing with the must meter already described.

Crystallized cane or beet sugar when pure has the same chemical composition and the same properties as grape sugar, and produces by fermentation an alcohol of neutral taste identical with that produced from grape sugar. It should, therefore, always be used in sugaring wines. If too much sugar be added to the must the same inconveniences arise that occur in the case of grapes naturally too rich in sugar. The amount of sugar employed should not exceed the quantity required to give the wine 12 per cent of alcohol. The amount of sugar necessary to be added to the must having been determined, it is dissolved in must drawn form the cuve and poured over the cap immediately after the tumultuous fermentation has ceased and at the moment when the husks begin to sink in the liquid. The husks and must should be thoroughly mixed, repeating the operation several times. The sugar may also be added to the grapes from time to time as the latter are being filled into the vats, and this method is necessary if the Perret vat be used. In cold regions, however, it is the practice to put off the introduction of the sugar until the must has begun active fermentation.

The Addition of Alcohol or Brandy.—Alcohol or brandy are added directly to the wine to give to it the degree of alcohol which it lacks. This practice is especially common in all the fortified wines, and in fact most of these had their origin in the addition of alcohol to secure their preservation. The amount of alcohol is increased directly by the addition either of this substance or brandy, to the

cuve after the fermentation has nearly subsided. If added at the beginning of fermentation the action is checked. The use of brandy was formerly more general than it is at present, its high price in recent years having led to the very general use of sugar in its stead. Much damage has been done to the trade in European fortified wines by the use of potato and other cheap grades of alcohol for this purpose.

Watering Wines.—The ill effects arising from musts too rich in sugar have already been pointed out. In France this is rarely an inconvenience, because in the regions where this excess is apt to occur the grapes are utilized in the manufacture of sweet wines, a subject to be considered later on. When watering is practiced, however, the water to the amount indicated by the saccharometer is added to the grapes in the fermentation casks. With certain grapes rich in flavor and color both water and sugar are added without, it is affirmed, injuring the quality of the wine. Blending grapes or wines of different saccharine strengths is always preferable to direct addition either of alcohol or sugar, which at best produces a dry wine lacking in finer qualities, whereas by the other methods the fruity characteristics are preserved.

The use of Plaster.—Plaster or gypsum (sulphate of lime) is employed in the manufacture of wine in Italy, Spain, and in the Midi of France or in the warm Mediterranean regions. To understand the action of the plaster it is necessary to remember that the wine is produced by the action of a ferment or microbe—a microscopic organism which decomposes the sugar of the must into carbonic-acid gas and alcohol. After this action is accomplished the presence of these organisms in the wine will lead to secondary action which is very prejudicial to the quality of the wine. The salts of lime and particularly the plaster have the property of precipitating by a mechanical action these ferments and are of use to free the wine from them. In addition to its clarifying action the plaster retards and prolongs fermentation useful to the complete transformation of the sugar into alcohol, causes the formation of tartaric acid, and increases the color of the wine by reason of the longer action of the alcohol on the skins of the grape. The plaster is ordinarily added as the grapes are being placed in the cuve, and at the rate of 2 grams per liter of wine. The use of plaster increases the amount of sulphate or bi sulphate of potash, which in any considerable quantity is injurious to health, and its use in greater strength than that indicated is prohibited by law.

The use of plaster is not practiced, nor is it necessary in the colder central regions of France where the sugar is rarely in excess in the must, which latter is also richer in acids.

Tartaric Acid.—Tartaric acid occurs normally in the wine and is sometimes added to it in lieu of the plaster. As is seen, the plaster

tends to augment this acid and thus give stability to the wine. The use of this acid is confined to south France, where the grapes are generally poor in acid elements. It is added at the rate of 100 grams. to the hectoliter of must, either to the must in the cuve or to the wine in tuns, or a portion is added to the must and later an additional amount to the wine.

WINE-VAULTS AND WINE-CASKS AND TUNS.—The wine cellar described in the foregoing part of this chapter, or often common barns, are frequently employed in lieu of wine-vaults in south France in the manufacture of the cheaper wines. In the central region where wines of much finer quality are produced and where it is necessary to store it for a period of several years to develop its special features the wine-vault is indispensable.

The Wine-vault.—The vault differs from the cellar in that it is built below the surface of the ground, is arched over, and so arranged that the temperature can be maintained between 10° and 15° C. The vault should be kept aërated, neither dry nor moist. The air should enter from the north, circulating constantly, and should be pure and free from any tainting odor which by penetrating through the pores of the wood of the tuns would injure the wine.

In all the famous wineries of France the new wine is left in the cellar after having been drawn off from the cuves until the slight fermentation which usually follows has ended, the conditions for this action being better there than in the vault. The wine is then racked again and taken to the vault.

Wine-casks and Tuns.—The vessels in which the wine is stored after being drawn from the fermentation vats or tuns, casks, etc., vary greatly in size. Those employed for transporting wine have a capacity of about 5 hectoliters. Those of 215 to 228 liters, used in Bordeaux and Bourgogne are popular, on account of facility in handling. Tuns not intended to be moved from the vaults are sometimes of enormous size. The tuns and casks are commonly of oak or chestnut, with hoops of iron which has largely replaced wood, and when properly cared for last for a long period.

The capacity of the wine cask has a marked influence on the maturing of the wine. Thus it is generally recognized that with increased size of the cask the wine matures more rapidly and also after maturity deteriorates in a shorter period. The reverse is true in the case of small casks in which the wine rather tends to remain stationary. Large tuns or casks are used with safety in the storage of wines rich in sugar and spirit or when they are kept in fresh, well-ventilated vaults.

In the making of the best French wines the use of the old casks for new wine is avoided on account of the liability of such casks imparting an objectionable taste to the wine. Thus in Bourgogne and in Bordeaux new casks are always employed. The advantage

of new casks is incontestable; the lees are deposited with greater facility and the fresh dry oak wood, well cleaned, is favorable to the preservation of the wine.

To cleanse and prepare new casks, in the larger establishments jets of steam are employed which are kept going until the water flowing out of the cask has no odor. Afterwards two rinsings with water are given, one with boiling water and the other with cold water, after which the cask is moistened with a small quantity of brandy. Sometimes common salt is added to the hot water to neutralize the acid principles of the wood.

To cleanse casks and tuns which have been emptied of wine, the lees and sediments are first removed and the casks are entered and thoroughly scrubbed out with a stiff broom, and then rinsed and dried. They are finally fumigated with burning sulphur. In the case of small casks that can not be entered, a chain scrubber is inserted with the water, and by rolling the cask back and forth the impurities adhering to the sides are loosened and washed off. Before filling them again it is a general custom to rinse them with a few liters of wine of inferior quality but good flavor.

FIG. 176.—Cleaning vats by steam. (Ergot, Paris, France.)

TREATMENT OF WINE IN THE VAULT.—If it be desired to mix the press wine with the cuve wine space must be left in the cask for this addition. The subsequent constant reduction of the volume of the liquid by the slight fermentation still going on and by the cooling of the liquid and also by its being absorbed to a certain extent by the wood of the cask necessitates frequent refilling of the casks, at first daily, then twice a week, and finally only once a month, and at less intervals with old wines. The importance of keeping the casks well filled can not be overestimated, as it prevents the development of noxious ferments. After fermentation has ceased the bung is loosely inserted, and four to six weeks after the wine was drawn off from the husks the cask is well filled and hermetically closed. It is important that the wine used in successively refilling the casks should be of the same sort, or at least of the same quality and age, as that in the cask, and a quantity is reserved for this purpose in small casks or in bottles. Small stones of silica well cleaned are sometimes inserted in the casks to make up for the loss

of the wine. In no case should alcohol or brandy be used for this purpose.

Racking Wine.—On being drawn from the cuve the wine lacks the limpidity and color which is afterwards assumed by reason of the presence of more or less of the skin, stems, etc., of the grapes. This solid matter induces still further slow fermentation.

Shortly after this fermentation ceases the wine begins to clear itself by the deposit of the solid matters held in suspension. A thick deposit forms at the base of the cask—the lees—and to prevent its becoming again mixed with the liquid the clear wine is racked or drawn off successively as many times as shall be necessary, oftener with fine than common wines.

No definite time can be assigned for the first racking, and no inconvenience arises from the wine remaining on the lees until warm weather begins. In France the wine is commonly first drawn off in March in the case of the finer grades. Common wines are generally racked in December. During the heated term of summer the wines are more or less agitated and additional lees are deposited, making it necessary to rack again, usually in August.

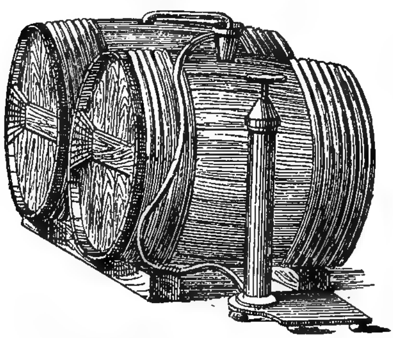


FIG. 177.—Racking wine by means of air pressure. U. Figus, Paris. France.

At the beginning of autumn and spring the changes of temperature influence and disturb the wine, and it is customary to rack it every year at these periods—March and September—until it is bottled.

The main precaution to be observed is to avoid as much as possible the aëration of the liquid unless it be desirable to hasten the maturation of inferior wines by rapid oxidation. Such aëration, however, causes the wine to lose both bouquet and color. The worst method, and one only practiced in small operations, is to draw the wines into small vessels and pour it directly into the new or freshly cleaned cask. The wine is preferably drawn off by means of a siphon, or by connecting the full and the empty cask with a pipe the wine is driven into the latter by forcing air into the former by means of a bellows or air pump (Fig. 177). In all extensive wineries the transfer is made by means of suction and force pumps, by the use of which the liquid does not come in contact with the air (see Fig. 178).

Filtering and Fining Wines.—Even when racked frequently and with the utmost precaution wines are frequently still far from being perfectly limpid. Some wines will, however, after standing for a long period deposit the solid matter held in suspension, and ultimately clear themselves, and such wines are in taste, color, etc., superior to wine frequently treated with finings, which causes it to

lose more or less of the elements which impart to it the oily, mellow, and fruity taste.

When the wine remains for a long period (after the third racking) without clearing, or when it is desired to clear it rapidly in order to put it on sale at an early date, recourse is had to filtering or fining.

Clearing by filtration is seldom perfect and is accompanied by certain inconveniences, viz, it is a long and tedious process, and it exposes the wine to the air, causing it to lose bouquet, alcohol, and to deteriorate generally. In the later filters (*à manches*) this loss is guarded against somewhat by inclosing the filtering device in a copper receiver. The Vigouroux filter (Fig. 179) is one of the best of this type; it consists of (1) a superior receiver in which the wine is poured; (2) a series of cylindrical sacks of woolen, linen or cotton which are attached to holes in the base of the receiver; (3) of a larger receiver inclosing the strainers and from which a tube conveys the liquid back to the cask. The illustration represents the

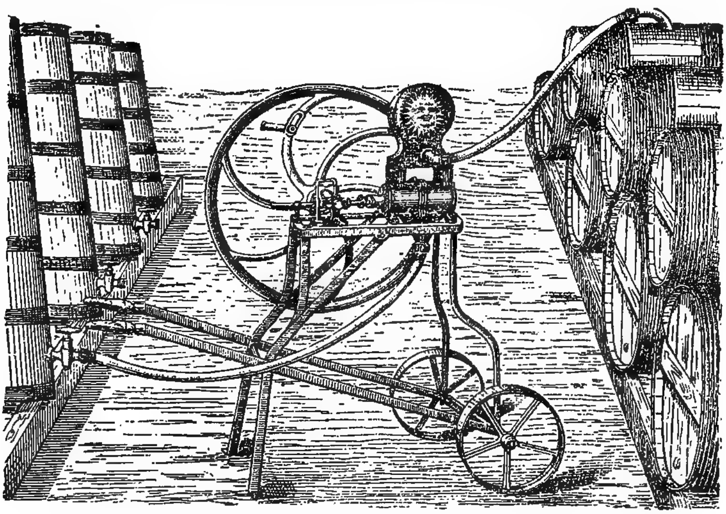


FIG. 178.—Pump used in transferring wine. Martin Frères, Augers, France.

method of using the filter, and at the right are shown entire and in section the cloth strainers employed.

By far the best and most important method of clearing wines, and the one very generally followed, is the addition of albuminous substances which the alcohol, acids, and particularly the tannin of the wine will coagulate and precipitate. For red wines the white of eggs is preferably employed because it does not precipitate the coloring matter of the wine. Sometimes common salt is added to the sizing, giving it weight and also preventing the decomposition of the lees.

With the use of white of eggs or beef blood the wine must be racked off after the action is completed; with the fish fining this is

not necessary, although it is generally advisable to draw the wine from the sediment as soon as it is cleared.

Among the mechanical agents are sand, kaolin, and paper pulp. The sand chosen is white and extremely fine and is washed carefully several times before being used. From 1 to 2 kilos of sand to the cask are employed. Pure kaolin exerts no deleterious effect on the wine and acts similarly to the sand. Care should be taken that the kaolin is not colored with the oxide of iron, which, while not particularly offensive in wine, is not a desirable addition. Preference should be given to white or slightly grayish kaolin.

The use of paper consists in reducing to a pulp unsized gray paper in a small quantity of wine and, when the paper is reduced to a thin, pasty condition, pouring it into the wine to be cleared.

With these three agents the wine is freed from the solid matter in

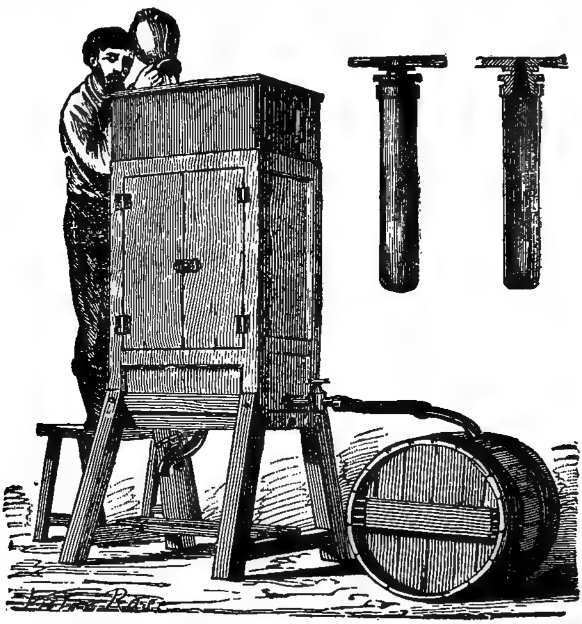


FIG. 179.—The Vigouroux filter. (From Rougier.)

suspension by these latter being carried down with the heavier solids through the liquid.

Among the clarifying agents which combine with the acid in the wine to form more or less insoluble salts are chalk, pulverized marble or shells, and plaster. The first three, which are nothing else than carbonate of lime more or less pure, combine with the acid elements of the wine to form lime salts, which, by their precipitation, act mechanically to clarify the wine.

The importance of the acid element in the wine, however, is so great, as has already been pointed out, that its abstraction by the use of these clarifying agents in excess may result in greatly injuring the

wine and bring about its decomposition or the precipitation of the coloring matter, etc. Even small quantities will, in particular cases, change an excellent product to a very inferior one. Plaster acts in much the same manner, and the use of these substances, particularly the former, should be in very limited quantity and is not particularly recommended.

There are two methods of sizing with the whites of eggs. In the case of the higher-grade wines the whites of five or six eggs are beaten up with a wooden beater and mixed with a small quantity of wine and the whole agitated thoroughly. The composition is then poured into the wine to be clarified and the whole thoroughly and violently agitated or stirred up. The tannin and alcohol, etc., of the wine precipitate the albumen of the eggs, and the solid particles in the wine are carried with the coagulated albumen to the bottom of the cask.

The second method differs slightly from the first and is employed in the case of the cheaper-grade wines. It consists in combining the whites of the eggs with a filtered solution of common salt, in which the former is more soluble than in pure water, while the salt is insoluble in alcohol. The eggs are beaten up as before and added to the wine, when the albumen and salt combine as a precipitate insoluble in alcohol and clarify the wine mechanically.

The common commercial gelatin is also generally employed to clarify wine. It is dissolved in hot water and added to the wine, forming with the tannin a more or less solid compound (tannate of gelatin) which acts, as with the substance already mentioned, to clarify the wine. With wine weak in tannin it is sometimes advisable to add 15 to 20 grams of tannin to the barrel to facilitate and complete the action.

The fish fining or isinglass, obtained from the air sac of the sturgeon (*Acipenser huso*), acts in the same manner as gelatin, and is preferred for the finer white wines on account of its greater purity. About 5 grams are taken for a cask (225 liters) of wine, and pulverized and macerated in a small quantity of wine, and allowed to stand for one day. A little tepid water is then added and the whole thoroughly mixed and broken up by hand, and then added to the wine.

The blood of animals is also used for fining, either entire or various portions of it, as with the fibrin removed or the serum alone. The latter only is recommended, as the coloring matter of the blood is objectionable. The serum is very much like the white of egg in composition and acts in a similar manner as a clarifier.

Milk is also used, but, like blood, is not to be recommended.

The best substance, therefore, in spite of its greater cost, is the white of eggs, except for white wine, for which the fish fining is preferable.

It sometimes happens that clearing proceeds very slowly, in which case the action is facilitated by adding 10 to 15 grams of tannin and 20 to 30 grams of tartaric acid per hectoliter of wine.

Fining is not always practiced in the case of red wine, except when it is intended to bottle it; with white wine fining is nearlv invariably practiced.

Mutage, or Additions to Wine to prevent Fermentation.—Mutage of the French wine-makers consists in adding to the wine a substance which will prevent undesirable fermentation. The amount of alcohol contained in a wine determines the length of time that it may be safely kept. If the wine is weak in this element and it is desired to transport it a considerable distance, it is necessary to increase its percentage of alcohol. The addition of the latter has a similar effect to sugaring during cuvage and is practiced chiefly in the case of the weak wine of central France. The alcohol employed should be obtained from grapes, but the high price of this alcohol leads to the common use of alcohol obtained from grains, which imparts a special taste to the wine easily recognizable.

The same end is also accomplished by mixing wines, that is, combining wines weak in alcohol with others strong in that element. For this purpose the wine-makers of central France procure especially from Spain and Portugal strongly alcoholic and richly colored wines to mix with their own product, obtaining by this means solid, well-colored wines.

Weak wines are given stability also by burning a small quantity of sulphur in the cask. The sulphur fumes becoming incorporated with the liquid prevent the development of noxious ferments. A burning sulphured wick is introduced at the bung, and at the same time a small quantity of wine is drawn off at the spigot, leaving a space which is filled by the gas. The wick is then removed, and the cask closed and agitated vigorously until the gas is absorbed by the liquid. The wine drawn out is then poured back. Treated in this manner, the operation being repeated several times if necessary, wine will remain without alteration for a long period. The slight taste of sulphur acquired can be removed by aërating wine just before it is bottled for consumption.

SPECIAL TREATMENT OF WINES.—Wines destined to be transported long distances are submitted to special treatment to increase their stability. This consists either of congealing or heating the wines.

Congelation of Wines.—This consists in submitting them to a temperature below 0 Centigrade. The slight freezing causes a deposition of bitartrate of potassium, of coloring matter and nitrogenous matters. The wine is then racked and should be kept at 0 centigrade for one month, when it is again racked and the temperature brought up to the normal. This treatment frees the wine from the substances that would facilitate fermentation and has concentrated it by the loss of water in racking when slightly frozen, the percentage of alcohol being thus augmented. The freezing is either accomplished by removing the wine to open sheds in winter or by artificial means.

Chauffage (*Pasteurizing*), *or heating Wines.*—By raising the temperature of the wine more or less, the various ferments contained in it are destroyed. This treatment is given more particularly to the higher grade wine and also to common wine intended for transportation. The wine may be heated in bottles or casks, or in special vats.

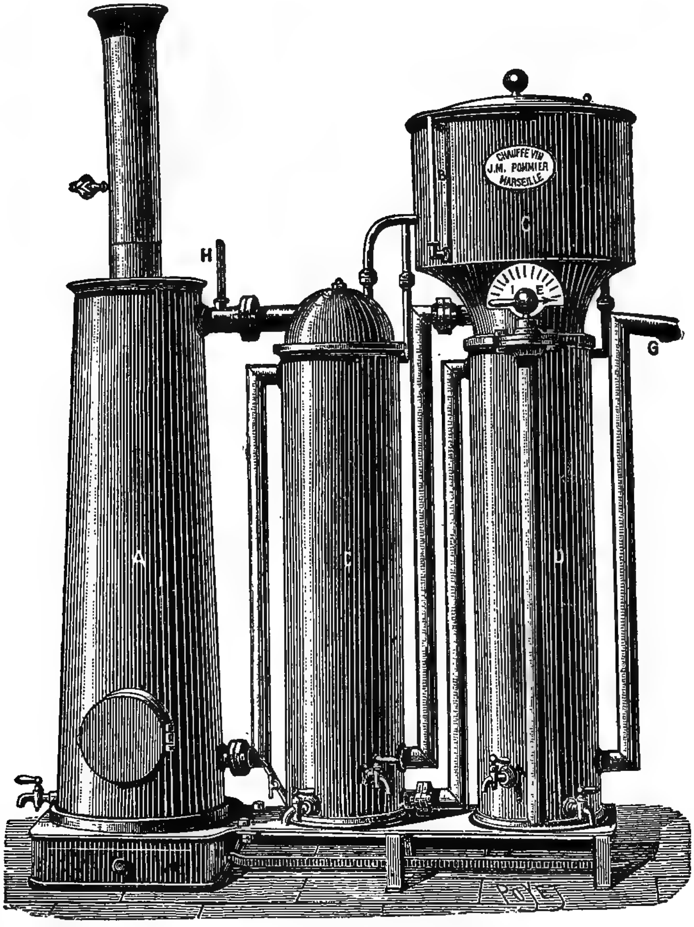


FIG. 180.—Pommier Wine-heater *Chauffe-vin*). (From Rougier.)

The methods of heating wine as well as the appliances for the purpose are exceedingly numerous. In warm regions the wine is heated by the natural temperature, being placed in situations under roofs or shed, etc.; furnaces and even the heat of dung piles are utilized for this purpose. The duration of the operation depends on the degree of heat attained; at 30° C. a month is required; at 40–50° 8 to 10 days will suffice.

A much more scientific method is by the use of machines invented for the purpose by means of which the wine is raised quickly to a temperature of from 65° to 70° C., which temperature has been shown by Pasteur to effectually destroy all the ferments.

Of the many machines, space will be taken to describe but one, the Pommier apparatus sold by the society, L'Avenir Viticole, of Marseilles.

It consists of a reservoir C, of two cylinders DD, of a heating apparatus A, and of a system of piping for the passage of the wine. The wine is poured directly into the reservoir C, from which it passes through the stopcock E into the cylinders D. After passing through the cylinders it reaches the apparatus A, where it is heated; it is then conducted by special tubes into the interior of the cylinders D again, where it is cooled by its passage through the cold wine moving in the opposite direction. The temperature indicated by the thermometer H varies inversely to the rate of flow of the wine, so that by regulating the latter by the stopcock E, any desired temperature can be maintained.

The question of heating wine is still somewhat of an unsettled one, but the operation without doubt tends to the preservation of the wine, and is recommended particularly to arrest any fermentation or alteration that may have commenced.

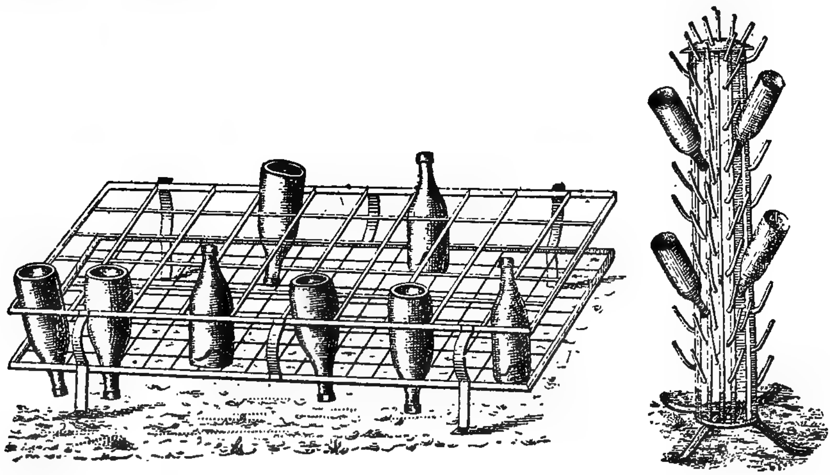
BOTTLING WINE.—No definite period can be given for bottling wines; they may remain in casks from fifteen months to four years or more. The common wines are disposed of at the end of the first year; the finer brands require a much longer time to develop their special qualities. As has already been noted, wine is constantly in a state of transformation, the rapidity of which depends on the size of the containing vessel. At a certain period it has acquired its maximum value and begins at once to deteriorate. By bottling, the wine is held in a state of almost complete quiescence, and having attained the best condition, will remain in that state for a long period.

The determination of the proper period for the bottling of the fine wines is an art and requires the ability to estimate, by taste, aroma, or bouquet, and color, the exact period when the wine has reached its best condition. If bottled too soon, the wine retains its green or partly matured condition, and if delayed much after the point of perfection is reached the resulting deterioration can not be corrected.

Before being placed in bottles, wines should have entirely completed fermentation, the excess of tartar, mucilaginous substances, albuminoids, and acids should have been removed, and the wine should be perfectly clear—that is to say, free from solid matter.

Bottling should not be undertaken for a month or six weeks after fining. The earlier that it is possible to bottle wine, the better will be preserved the characteristics of aroma, bouquet, and fruity taste.

The time of the year for bottling is still in dispute; generally March and September are the months chosen. Some noted wine-makers, however, prefer July.



FIGS. 181 and 182.—Racks for draining bottles. (Barbou fils, Paris.)

For the finer grade wines the choice of bottles and corks is most carefully made and considered of the greatest importance. In the case of the former it is found that the composition of the glass may exert a prejudicial influence on the wines—as, for example, the presence in the glass of a superabundance of alkali which will be acted on by the wine.

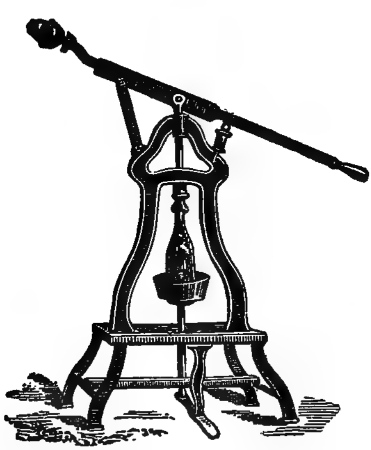


FIG. 183.—The Guillot corker. (From Rougier.)

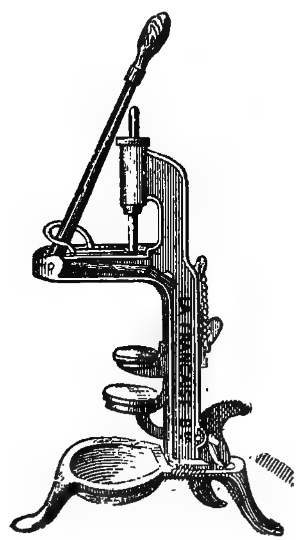


FIG. 184.—La Française corker. (U. Figus, Paris, France.)

The bottles to receive the wine are prepared with greatest care by being thoroughly washed and drained. The corks should be long

and of the best quality, and are well cleaned, and softened and tempered by soaking either in water or preferably in a small quantity of the wine that is to be bottled. They are inserted by hand or with a machine (Fig. 183 and Fig. 184).

If the wine is to remain long in bottles it is customary to protect the cork from the attacks of insects by coating it with a sealing wax of any desired color. The bottles are then stored in a cool place, not moist, but dark, to avoid the decoloration of the wine by the action of the light. They are placed in such manner, commonly on the side, that the cork will be completely covered by the liquid, and

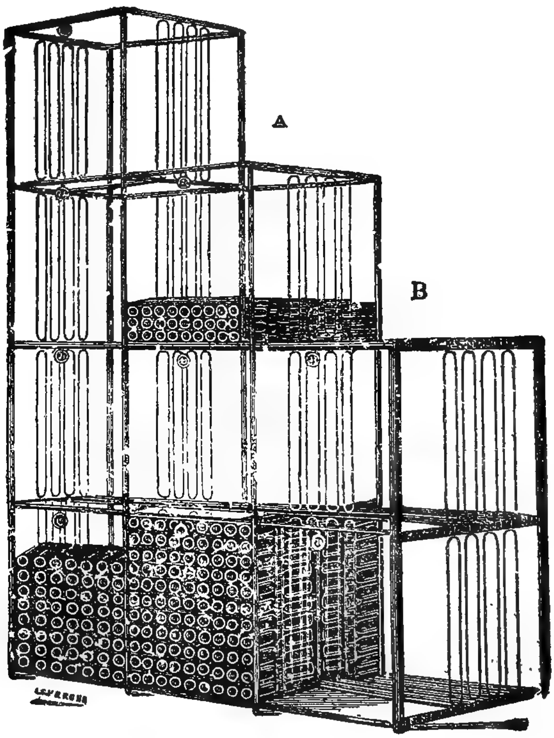


FIG. 185.—Rack for wine bottles. (G. Pepin fils, Bordeaux, France.)

are kept either in dry sand or on special racks of wood or iron (Fig. 185).

A deposit will frequently form in the bottles, making it necessary to decant them into other bottles, which should be slightly smaller than the first. Great care should be taken not to disturb the sediment, and to obviate the danger of this, various transferring devices are employed, of which common styles are shown at Figs. 186 and 187.

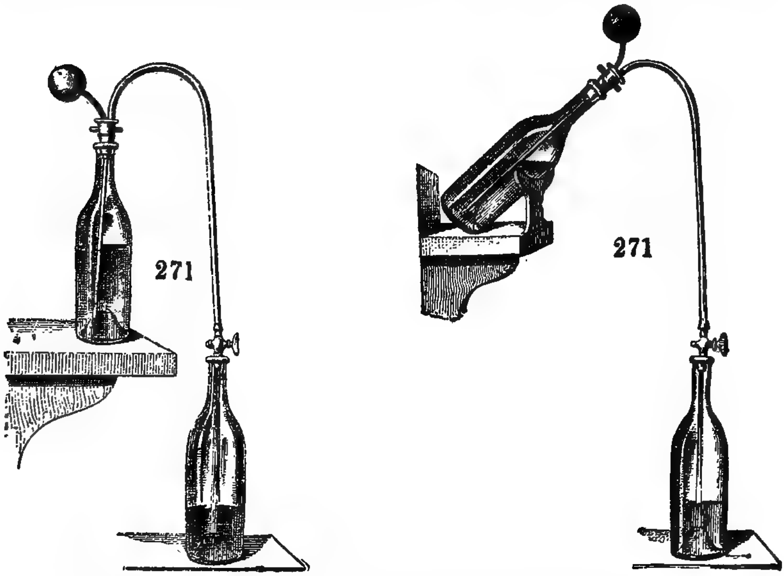
DISEASES OF WINES.—A few only of the leading maladies to which wines are subject are noted. In general, if proper precautions have

been taken in the gathering and manipulation of the grapes and must, no bad results need be feared.

Acid Wines.—The acidity of wines is due to the transformation of the alcohol into acetic acid under the action of the oxygen of the air and heat, and generally results from the exposure of the wine to the air for a longer or shorter period.

If measures are taken at the start the acidity may be corrected—(1) by racking into a well-sulphured cask; (2) by sizing repeatedly and thoroughly; (3) by adding alcohol; (4) by heating. It is difficult to entirely remedy the defect, and such wine is usually disposed of, consumed at once, or sent to the distillery.

Flat or turbid Wines.—This disease results from a decomposition which leads to a putrid fermentation. It occurs in wines poor in



FIGS. 186 and 187.—Decanting apparatus. (George Pepin fils, Bordeaux, France.)

alcohol and containing a large amount of albuminous material. The disease is remedied by transferring the wine to a freshly sulphured cask and adding alcohol. The wine should also be fined and after a few days from 25 to 30 grams of tartaric acid should be added per hectoliter.

Greasy Wines.—This occurs with white wine in casks and especially in bottles, and also, but to a less extent, affects the red wines. It is characterized by the production of oily and mucilaginous substances, which rise to the surface of the wine.

In general, wines weak in alcohol and tannin, produced from inferior or insufficiently ripened grapes, are subject to the disease. The addition of tannic acid, from 15 to 30 grams per hectolitre of wine, is effective in both preventing and remedying the disease. By agi-

tating the liquid the oiliness disappears temporarily, but to complete the cure the tannic acid must be added.

Bitter Wines.—The wines of Bourgogne are particularly subject to this affection. It first manifests itself by an insipid flavor which soon becomes bitter. The coloring matter alters also and precipitates to the bottom of the vessel. The change is due to faulty methods and to poverty of the wine in alcohol and acids.

At the start it may be corrected by fumigation with sulphur, as already described, followed with a vigorous fining. To remedy the composition of the wine, alcohol to the amount of 2 per cent is added, together with 10 grams of tannic acid and 50 grams of tartaric acid per hectolitre of wine.

SPECIAL WINES.

Having discussed the general subject of wine-making in France necessarily, however, in the briefest manner, it remains for me to speak of the principal special wines which do so much towards the establishing and maintaining the reputation of the country the world over for its wonderful vine products.

These special products are in white wines, rosy wines, foaming wines, sweet or liquorous wines, and less important but none the less interesting the wines produced from raisins or dried grapes.

WHITE WINES.—*Characteristics and Process of Manufacture.*—The white wines are made from the pure juice of the grape and from both white and colored grapes, the wine from the latter at first presenting a slightly reddish tint which afterwards disappears. Immediately after gathering the juice is expressed from either red or black or white grapes before any fermentation sets in and avoiding any maceration of the berries, and being fermented produces an almost colorless wine.

While the red grapes or a mixture of the red and white grapes are not infrequently employed in the manufacture of white wines the fact remains, however, that in all regions where the more famous wines of this sort are produced, white grapes are exclusively employed, and these are frequently allowed to hang long after ripening on the vines even until the leaves have fallen.

The utmost precautions are used in the gathering, sorting, pressing, and subsequent steps of manufacture with both red and white grapes. In the case of red grapes, which are gathered well ripened and all broken and fermented berries removed, the pressing is immediately and most carefully done with comparatively small lots and stopped the moment colored juice begins to flow.

In the case of the exclusive use of white grapes—the gathering is done during the warmer part of the day and during a dry period—the same precaution being used as in the matter of broken or fermented berries; for, little color as has the skin of the white grape, it

is nevertheless sufficient to impart under the action of fermentation a decided tint and flavor to the wine produced.

Previous to the introduction of the grapes into the press, in the more celebrated wine districts, as *Haut Médoc*, they are sometimes placed on an inclined table and submitted to a gentle crushing or treading under bare feet, which results in the securing of a small quantity of the juice of the grape, and from this is produced the famous wine for the year of that variety and vineyard. The grapes are then pressed in the ordinary manner, the resulting wine frequently being disposed of by the reputation of the first pressing. The must is put in casks which are left with the bung open throughout the period of fermentation, and afterwards submitted to the various treatments described for red wines.

This wine possesses particular properties by reason of its fermentation apart from the skin, stems, etc. The fermentation is slower and less heat is generated, which results in a smaller loss of alcohol and also of the various principles constituting the bouquet. The white wines in general therefore are stronger in alcohol and aroma than the red wines. On the contrary they are poorer than the red, in the principles coming from the skins, seeds, and stems, viz, tannic and tartaric acid, mucilage, etc.

The white wines are nerve stimulants; their effect on the system is rapid but not lasting. The red wines on the contrary are more nutritive, hygienic, and more easily digested, and hence better adapted for general use.

The utensils—presses, casks, etc., employed in making white wine should be used exclusively for that purpose, or else should be carefully cleaned to remove all coloring matter.

The grapes being pressed immediately after being gathered and put at once in casks, the wine contains a large amount of albuminoids and is weak in acid principles. The albuminous matters come largely from the pulp, and instead of being deposited as in the case of red wines, remain longer in solution, owing to the feebleness of the liquor in tannic acid and the slowness of the fermentation. To hasten the defecation of these wines the temperature of the cellar for a portion of the winter must be kept at a point that will facilitate fermentation. The wine should be racked more frequently than in the case of red wines and preferably in the presence of air. The fining or sizing should be energetic, and to make it effective it is necessary to add from twenty to thirty grams of tannic acid per hectolitre.

The white wines are classified as *dry*, *sweet*, or incompletely fermented, and *alcoholic*. The liquorous white wines are treated in a special section later on.

Dry white Wines.—In these wines the sugar is entirely converted into alcohol, and the bouquet is at its maximum.

The method of producing this wine is not intricate, and is applicable only to wines naturally strong in alcohol. The pressing is somewhat prolonged rather than hastened, and the receiving vat is not entirely filled. The wine is then left without other treatment until May or June on the lees to accelerate and complete the fermentation (sometimes being drawn off in February), when it is ready to be bottled.

Sweet or incompletely fermented white Wines.—These are intermediate between the dry wines and the liquorous or fortified wines, and are made by checking fermentation before the sugar is all converted into alcohol. To arrest the fermentation it is necessary to practice *mutage* as soon as the wine leaves the press. The vapor of sulphur, as already described, is also employed. These wines should be preserved in cool cellars and may be kept fresh all winter.

Alcoholic white Wines.—These differ from the dry wines only in containing a larger proportion of alcohol, and are usually made in the warm parts of France where the grapes are rich in sugar and the heat facilitates fermentation. The natural maximum of alcohol in wines is from 14 to 15 per cent. A larger percentage is obtained by adding the alcohol directly to the wine. The addition is made after fermentation to avoid arresting that action.

SWEET OR LIQUOROUS WINES.—These wines, made from both white and black grapes, contain a certain proportion of unconverted sugar after the fermentation has ceased. They are produced chiefly in warm countries in which the temperature is high and the climate more or less dry, which induces in the grapes the formation of a very high percentage of sugar and a much more marked aroma than is found in grapes grown in cooler climes. These wines, while produced largely in the south of France, are more familiarly associated with Spain, Portugal, the Mediterranean countries, and the warmer portions of southern Europe. Of this class are the wines of Malaga, Madeira, Candia, and the unexcelled Tokay wines of Hungary. The necessity for a high percentage of sugar in the grapes leads to the postponement of the vintage for as long a period as possible in order that the grapes may lose by evaporation a large portion of their water contents. By this means the sugar undergoes a certain transformation also, which seems to act very favorably in the production of the desired qualities in the wine. Wherever this natural ripening on the vines will produce the requisite amount of sweetness, the best liquorous wines can be produced. In more northern regions, however, the same end is reached by artificially drying the grapes. To produce a good wine of this class, the must should indicate at least 20 per cent when tested with the glucometer, or in other words sufficient sugar to develop by fermentation 20 per cent of alcohol, of which the mature wine will contain in the neighborhood of 15 per cent and the balance will be free sugar. This results in the for-

mation of a wine which is at once alcoholic and sweet or what is termed liquorous. In the case of grapes again, in very warm regions, which will acquire naturally sufficient sugar, the only precautions necessary are to secure sufficient evaporation to bring the sugar to the proper percentage. This is accomplished by removing the grapes and allowing them to evaporate some of their water under the action of the sun and air. Usually a reduction of about one-third in weight by evaporation will be sufficient for the purpose and will be secured after an exposure of five or six days. The grapes are then carefully sorted and subjected to a slight crushing, after which they are pressed and the must is stored in small barrels, in which the bung is inserted loosely so that the beginning of the fermentation can be observed. The action is checked by removing at frequent intervals the cap raised by fermentation, thus withdrawing from time to time a considerable portion of the active element of fermentation and preventing the complete transformation of the sugar into alcohol. The liquid is then carefully drawn off and filtered, the operation being repeated several times until all fermentable matter is separated. If the weather is such, on account of excessive rains or otherwise, as to prevent the natural drying of the grapes on the vines, this is accomplished under protection or by means of special evaporators or drying ovens.

The process outlined above results in the production of the best liquorous wines. Any other process which will result in securing the desired percentage of sugar by artificial means is applicable to regions which are less favorable to the production of sweet grapes, In colder regions after having ripened as much as possible on the vines or up to about the time of the first frost, the grapes are gathered in the warm dry days and separated out on beds of straw, or, better still, are suspened in the air, either by the stems or preferably near the tip of the bunch, so that the grapes will separate from the stem and allow a more ready passage of the air and evaporation. When hung up on wires, in the manner last described, the evaporation is somewhat more rapid than on straw. As soon as the evaporation has gone far enough to bring the concentration wished, the grapes are carefully separated from the stem and sorted, crushed in small lots, and reunited in large tuns, to remain about twenty-four hours or until the commencement of the fermentation. The wine coming from the press is usually divided into two lots, the first of which is softer and more agreeable in flavor than the last, which is inclined to be more alcoholic and somewhat astringent. The marc, which still contains a considerable amount of sugar, is employed in making cheap wines, and is frequently used to add flavor to and increase the percentage of alcohol in inferior white wines. This somewhat artificial process of making these wines is very similar to that employed in the celebrated vineyards of Tokay, the difference being

that in Tokay the grape ripens so early and the dryness of the climate is such that the drying of the grapes takes place on the vines instead of under artificial conditions.

The description given above relates only to white grapes. With black grapes the process is the same up to the point of crushing the grapes. At this step they are placed in barrels which are two-thirds or more filled. The bungs are closed with tapering plugs so that it is possible for the passage of the gas arising from the fermentation without allowing the exterior air to enter. When the fermentation is nearly finished and the liquid has assumed a good color, it is drawn from the barrels and to it is added the juice obtained by pressing the marc, the latter giving it additional color and force. The fermentation now continues to completion, when the liquor is carefully drawn off.

There are still other methods of artificially producing the required amount of sugar in grapes. One of the oldest is that given by Columella, which consists in subjecting the grapes to the action of ash lye which has been carefully filtered. This causes them to evaporate more rapidly. Another method, which, however, is not recommended, and is not employed by the best wine- makers, consists in concentrating the must by boiling it in immense vats until it has acquired the desired density. It is usual to continue this until the density has reached 30° Baumé and then a sufficient quantity of non-reduced must is added to bring the density down to 20°.

In addition to the wines of this class, which are produced in favorable regions there are others made from grapes grown in comparatively cold climates or of grapes the ripening of which from other causes has been retarded. The methods employed are more artificial and the product is inferior. Preferably grapes are chosen which are naturally as sweet as may be, and which have considerable natural aroma, such as the Muscats and others of that category. These are gathered at as late a period as possible and are subjected to the drying process already described. To obtain the desired consistency, 18° to 20° Baumé, the must is boiled, and as soon as sufficiently concentrated is clarified with white of eggs beaten up with the liquid. When nearly perfect limpidity is reached, the whole is brought together in a large tun or tank and subjected to the treatment outlined above in the case of the other wine. Should the bouquet or aroma be insufficient, a suitable perfume or aroma is added artificially. In most vineyards, however, only a portion of the must is reduced by boiling and the reduction is carried to a point beyond that necessary if all were subjected to this action, and the normal density is secured by combining the reduced with the unconcentrated must. If the grapes are not sufficiently sweet, in some cases sugar is added directly to the must, or more frequently alcohol is added to the vats before the fermenta-

tion is complete, which arrests the fermentation and leaves in the the wine some of the natural sugar unchanged.

ROSY WINES.—These are known in France as *vine rosés* or *vins d'une nuit* (wines of one night), the latter phrase indicating the nature of their production.

They are made from red grapes of which the must has begun fermentation in the presence of the pomace. A portion only of the coloring matter is dissolved by the action of the alcohol, giving a slight tint to the wine. The liquor is drawn off after twenty-four hours or sometimes two days, and the subsequent treatment is the same as for white wines, which they approach in composition.

CHAMPAGNES OR FOAMING WINES.—The foaming or sparkling characteristic of certain wines is due to the presence of carbonic acid which they contain in solution and which when the wine is uncorked escapes and occasions an effervescence or foaming. In other respects they do not differ from other wines.

The interest attaching to these wines and their importance will warrant a fuller description of the methods of manufacture.

Wines of the Province of Champagne.—A more highly appreciated or celebrated wine than the foaming or sparkling product of the vineyards of the province of ancient Champagne is produced nowhere else in France or in any other wine-center of the world. This province belongs to the department of Marne and includes the districts of Rheims, Épernay, and Châlons. It has an area of vineyards of something more than 14,000 hectares, which, however, by intensive-culture methods is made to yield its utmost.

The broad fertile plains of Champagne, thanks partly to the superiority of the variety of grapes comprised in their vineyards, partly to peculiarly favorable climatic conditions, and also to character of soil and careful system of cultivation, have from time immemorial, almost, been famous for the flavor, bouquet, and freshness of their wine products. The praise of their red and white wines began to be recorded as early as 530 A. D.; but it was not till toward the close of the Seventeenth century that the foaming wines which have taken the name of this famous vine region began to be produced.

Discovery of foaming Wines.—Legend attributes the discovery of the method of producing sparkling wines to a certain Dom Pérignon, a prior in charge of the wine vaults of the Abbey d'Hautvilliers, near Épernay, and it was not long until the production of ordinary wines was abandoned in favor of the more celebrated product.

This discovery, doubtless accidental, was that by bottling the wine before fermentation had ceased, the subsequent transformation of the sugar in the liquid generates a quantity of carbonic-acid gas which is held in solution, but escapes with effervescence when the bottle is uncorked. For a long period after this discovery the only

way of determining the amount of sugar in the wine at bottling to produce the proper effervescence was to judge by the taste. The exact amount of sugar required for the best results is now known and apparatus for its accurate estimation are now in general use.

Variety of Grape.—Foaming wines may be made from the product of any vineyard of any region; but, favoring conditions and the benefit of traditional experience having given the first rank to the wines of Champagne, it is eminently proper to describe the processes employed in this department in preference to those of other regions.

On entering this famous district at harvest time, one is at once struck by the fact that, contrary to the natural supposition, more red grapes than white are grown and used in the making of Champagne and in fact the proportion is about three of the former (the *Pinot rouge* predominating) to one of the latter. The precautions employed in gathering the crop and expressing the must result, however, in obtaining an almost colorless liquid, which becomes nearly perfectly so after the first fermentation.

If the white variety be used alone a fine, light, fresh wine is produced, which is, however, usually too acid ; the black or red grape, on the contrary, produces a white wine less acid and with more body, but somewhat astringent and of better keeping quality. By combining the two grapes in the proper proportions the quality of must best suited for foaming wine is secured.

Gathering and Pressing and Treatment of Must.—It is difficult to appreciate from our standpoint the extraordinary care used in gathering the ripened fruit and in sorting out all bruised or in any way otherwise injured berries.

Pressing follows immediately after gathering without allowing the grapes to become heated by the sun and before the least fermentation has set in, the greatest cleanliness being maintained about presses and receiving tuns for the must. The presses are large, having a capacity of about 4,000 kilograms of grapes or about 40 of the willow paniers used in transporting the grapes from the vineyard. (See pp. 389–390 and Figs. 173 and 174.)

The first liquid to come from the press known as *vin de choix* or *vin de cuvée* is kept apart and constitutes the source of the best champagne ; the subsequent product is divided again into second and third lots, which latter, in the case of the more celebrated vineyards, are employed only in the manufacture of inferior and non-foaming wines. In other and less noted vineyards the results of all the pressings are put together and made into champagne. The second and third products need not be followed, as the further steps are the same as those already detailed. The *vin de cuvée* is allowed to rest for ten to twelve hours in a well-rinsed cuve or in casks, to allow the coarse lees and any other solid particles to settle to the bottom. When this has taken place the must becomes covered with a whitish

blanket, which indicates the beginning of fermentation and the commencement of the escape of the carbonic acid with which the liquid is now saturated. To further check this action, the liquor is at once drawn off from the heavier sediment into casks of about 200 liters capacity, which have been previously very carefully cleaned and sulphured to remove or destroy any germs of decomposition which they may harbor, care being taken, however, not to fill them until the fumes of sulphurous acid have nearly all escaped; otherwise the desired fermentation in the introduced liquor would be more or less completely arrested. When filled the casks are arranged in the cellar on supports or benches to remain untouched until January or February, except that, immediately after being stored, an addition of sirup composed of wine in which has been dissolved 500 grams of sugar per liter is made to insure in the wine after fermentation a percentage of alcohol between 10 and 11.5 to 12. The amount of sirup to be added must be determined by the must-meter and will vary with the maturity of the grape, its richness in sugar, or the demands of the market.

An excess of sugar will result in a greater strength of alcohol and if this exceeds the maximum of 12 per cent the germs of ferment are smothered or held inactive and the wine will fail to develop its foaming character, and this result has been brought about on several occasions by the natural but excessive sweetness of the grapes in particular years, notably in 1865, on account of peculiar climatic conditions leading to the development of an unusually large percentage of sugar in the berry. After the addition of the sirup 5 or 6 liters of the must are drawn from the casks by means of a siphon, to give space for the action of fermentation, and the bung is covered with grape leaves held in position with a piece of tile, so that the escape of the carbonic acid may take place without affording opportunity for the entrance of germs of decomposition from the atmosphere.

At a temperature of from 12° to 22° C. fermentation readily takes place and reaches its maximum and almost entirely subsides again in from five to eight days, the casks being filled up a little at a time as the action subsides.

The liquor or wine has now assumed a milky color and is allowed to stand for fifteen to twenty days, after which the casks are completely filled and the bung inserted, a small hole being made in the superior stave of the casks in which straws are inserted to permit the gas to escape without affording entrance to deleterious germs.

Winter Treatment—Combining Wines.—By January the coarse sediment of salts and organic matter has been precipitated by the action of the cold, and the wine has become limpid and ready to be racked off into clean casks. A small quantity of alcohol is added at this stage to make up the amount lost by evaporation during the

racking and transferring of the wine. During the months of January and February the different products of the vineyard, or, in the case of wine syndicates, comprising a large number of vineyards of the province, the products of all these "crus," are brought together to be thoroughly incorporated one with the other in wine tuns or vats of enormous capacity.

Experience has demonstrated that to obtain a perfect wine it is necessary to combine the new wine of different varieties of grapes or from different vineyards or, better still, provinces and also to mix the product of different years, by means of which the character of the type of the output is maintained uniform from one year to another, or the changes are so slight and transitional as to be imperceptible to the consumer.

This combination is one of the most important steps we have yet reached and for it rules or specific directions can not be given. The expert taster estimates the quality of bouquet, astringency, acidity, etc., of each cask and determines the amount or proportion of it which should be combined with other products or different varieties, vineyards, or years to produce the typical wine, and ability in this is only the result of long experience.

When the whole has become harmonized and homogeneous and ameliorated by combining one with the other, the wine of that year is practically formed and only needs, to be prepared for the market, the subsequent and yet important manipulations described below.

Treatment with Tannin and Fining.—In the case of the foaming wines it is even more important than with the others to remove at this stage any elements, such as organic matters, gelatinous or albuminous, which would induce a series of changes in the wine and cause it to deteriorate or be affected by various wine diseases. The addition of tannin renders these dangerous elements insoluble and removes, for the most part, the possibility of their inducing any alteration in the wine. It is, however, liable to leave the liquid more or less astringent and affects, to a certain degree, the softness and mellowness of the wine. Hence the addition of tannin should be made with some care, and the amount usually employed in champagne wines varies between 5 and 10 grams of the pure article to each barrel of the capacity of 2 hectoliters. It is, nevertheless, necessary to have a certain excess of tannin in the wine after fining, to prevent the slight precipitates, which will occur after bottling, from adhering to the bottle. It is also sometimes necessary, and in fact is the usual practice, to add a small amount of tartaric or citric acid at this time. The transference of the wine from the smaller casks to the immense tuns in which the different products are thoroughly incorporated, results in a certain loss of alcohol by evaporation, and this must be made good by the addition of an equivalent amount of pure alcohol, care being taken, however, not to bring the percentage

of alcohol above the amount already given, viz, 11° to 12°. The thoroughly homogeneous product is now again drawn off into small casks to undergo the process of fining, which is similar in the case of these wines to the methods already described, except that in the case of champagne wines the fish fining only is used. The method of fining these wines is of interest, and is thus described by M. Salleron:

In a small wooden vessel or barrel about 250 grams of isinglass, broken into small pieces, are placed, and to this wine is added from time to time to the amount of 20 liters, the mixture being meanwhile violently agitated with a rush brush. This mixture is then allowed to stand for three or four days, and, when the fining is thoroughly dissolved in the wine, the whole is drawn off into a small barrel and vigorously agitated while about 80 liters of old wine are added, a little at a time. The resulting sirupy mixture is added to the wine to be fined in the proportion of 2 liters to 200 liters of wine. The barrels containing the wine are then agitated violently by striking them with a mallet to cause the fining to penetrate throughout the entire mass of the liquid. After this operation the barrels of wine are removed to the cellar and after the fining has settled they are racked off and resized two or three times, following the same methods. At the opening of spring, or about the time the sap begins to circulate in the trees, the wine, influenced by the elevated temperature, begins to undergo a slight fermentation, and this indicates the period to begin the process of bottling.

Racking.—The wine, which during the winter has been carefully fined and clarified in the wine caves and kept free from deleterious ferments and germs by frequently filling the barrels, is now racked off for the last time to remove from it the various organic matters which have been separated by the addition of the fining, and to free it from the larger part of the elements of fermentation which have been carried down in the sediment. Care must be taken, however, not to rack it so carefully as to obtain a liquid entirely free from the germs of fermentation, as this would result in a wine which would not produce any of the foaming characteristics of the champagne wines because lacking the small element of fermentation necessary to produce the action in the wine after bottling. It is necessary, therefore, in drawing off the wine to have it slightly troubled or clouded from the removal with it of a small portion of the sediment containing the germs of fermentation. To be assured of the presence of sufficient spores of fermentation, it is customary to make a microscopic examiniation of the wine, and if the racking has been done too carefully and the wine does not contain enough of the ferment, some wine containing a considerable quantity of the ferment is introduced in each barrel. A certain aëration is also necessary to bring about this subsequent fermentation, but the necessary amount

of oxygen will usually be taken up by the wine during the process of racking and the subsequent bottling.

Sugaring.—The necessity for the addition of a small amount of pure cane sirup to the wine previous to bottling, to insure the production of carbonic-acid gas by subsequent fermentation, has already been referred to, and the amount to be added is a matter of very considerable moment, varying with the amount of native sugar in the grape. If too much sugar be added the production of the gas will be so great that an excessive percentage of the bottles will be broken; while, on the other hand, if too little be added the gas will be developed in insufficient amount. From numerous examinations and tests, it has been found that the normal pressure of the best champagnes is about five atmospheres at a temperature of 10° C., and this is a maximum amount, which should not be exceeded. It has been found also by experiment that a gram of crystallized sugar, by the action of fermentation, will produce 0.247 liter of carbonic-acid gas and 0.643 cubic centimeter of alcohol. The amount of unconverted sugar in the wine can easily be determined by means of the apparatus called the gluco-œnometer. Mr. Salleron has calculated the coefficient of the absorption of the gas at a temperature of 10° C., without pressure, to be 0.820 liter, and, therefore, to produce a pressure of five atmospheres, 5 times 0.820, or 4.1 liters, is the volume of gas which should be liberated by fermentation from the sugar. The amount of sugar necessary to produce this amount of gas is found by dividing 4.1 liters by 0.247, the amount stated above to be produced by one gram of crystallized sugar, the quotient of the operation being 16 grams; therefore an amount of free sugar should be added to the wine per liter to bring the content of unconverted sugar up to 16 grams. The crystallized sugar added to the wine is dissolved in a good white wine, usually of the same vintage as the wine to be bottled. The sirup thus produced, containing a known quantity of pure cane sugar, is added to the wine, in an immense cask, provided with a powerful agitator, which not only insures the thorough mixture of the sugar, but also results in the aëration of the wine, which is essential to the satisfactory development of the ferment.

First Bottling.—The wine is now ready to be bottled, and in the accomplishment of this there are two methods each having its own advocates and each possessing certain advantages. One consists in bottling the wine in a cellar at a temperature of 15° to 20° C. and the other in the cooler, deeper wine caves at a temperature of 8° to 9° C. The difference in the two methods is supposed to be the slight change which results in the foaming character, but in many of the larger wineries of Champagne both methods are combined as follows: The wine is bottled and the fermentation allowed to begin in a cellar at the higher temperature and when the pressure has

reached about four atmospheres the bottles are lowered into the inferior cellar or cave and maintained at a lower temperature until the maximum pressure of five atmospheres is reached. The work of bottling should be done with all possible expedition, since, after the addition of the sugar, the fermentation will begin at once and there will be a constant loss of the gas. The bottles are of a special quality and must be very strong to resist the pressure of the gas, and they are always cleaned and prepared with the utmost care. The transference of the wine to the bottles is made either with a small faucet or, in the larger establishments, by means of a siphon. The corks are of a special brand and exceptional quality and are inserted by means of machines which have already been described. The fastening of the cork is done either with a wire or with a special clasp which is forced over the cork and hooked to the neck of the bottle by a special machine, with which a skilled workman can fasten from two to three thousand bottles per day.

Measuring Pressure of Gas.—The sole object of the special treatment of these wines is the production of the carbonic-acid gas which causes their peculiar foaming characteristics, and it is of interest to be able to determine at any time after bottling the degree to which the carbonic-acid gas has been produced. For this purpose an instrument called the manometer has been devised, which may be introduced into a number of bottles in each lot and can be examined from time to time to record the pressure in atmospheres. This little glass instrument is represented at Fig. 188. It is introduced into the bottle with the wine after the short branch containing mercury has been broken at the tip. As the pressure of the gas in the bottle increases, the mercury is driven up in the longer graduated tube. One or two bottles containing these instruments in a rack holding one hundred or more are sufficient to determine the rate of development of the gas.

FIG. 188.—The Manometer. (Copied from Partes and Ruyssen).

In addition to the small manometer already described, a special apparatus has been devised by Salleron to determine more exactly the pressure of the gas in the bottles. This instrument is shown at Fig. 189. It consists of two distinct parts, one a steel tube or probe, S, surmounted by a stopcock and manometer, M. In place of the removable manometer a cap, P, may be screwed to the upper extremity. The probe is closed at the tip by a small steel tip. In using the instrument the cap, P, is screwed on in place of the manometer and the probe is thrust through the cork until the point projects into the liquid, when the steel point will fall of its own weight, leaving the tube in direct connection with the interior of the bottle. The manometer is then screwed on in place of the cap P, and on

turning the stop-cock the pressure is indicated on the dial. The amount indicated will always at first be considerably below the true pressure and the latter will not be shown until the bottle has been vigorously agitated. This test should be made with the liquid at a temperature of 10° C.

Trays for Storage of Bottles.—For the storage of the wine in bottles special racks or trays are made, which are so constructed that the bottles are sufficiently separated to prevent injury to the neighboring bottles in the event of the explosion of any of them. A single tray will frequently contain ten thousand bottles and the separation serves also to diminish the rise in temperature which the fermentation occasions. When, by inspecting the bottles containing the manometers, the pressure is found to have reached about four atmospheres, the trays containing the bottles are lowered bodily by means of derricks into the lower cellar or cave, there to remain until the transformation of the sugar into alcohol and carbonic-acid gas has been completed.

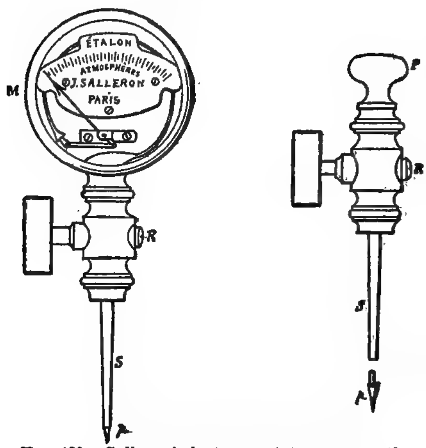


FIG. 189.—Salleron's instrument to measure the pressure in champagne bottles.

Subsequent Manipulation of Bottles.—The wine is left in this condition for a year or two to obtain the complete transformation of the sugar and to develop the special ethers or bouquets which give the wines of each famous vineyard their distinctive character. At the end of the first year, however, or about November or December, it is necessary to change the positions or rotate the bottles on the trays to prevent the adherence to the glass of a certain sediment or lees which will be precipitated by the fermentation. At the end of a year or two this fermentation will have been completed and the wine will have become perfectly clear. It is now necessary to remove the sediment which has collected in the bottle. This is done by placing the bottles in trays in such a manner that the neck points downward at an angle of about 60 degrees, and each day for a period of six weeks or two months they are regularly gone over and each bottle turned half way about, which results in causing the lees or sediment to collect about the cork, leaving the sides of the bottle and the wine itself perfectly clear. If the wine has been properly treated and sufficient tannin has been left in it, the deposit will be more or less granular and pulverulent and will, by a slight agitation, easily be caused to pass through the liquid and collect on the cork. An

insufficient percentage of tannin will sometimes result in a deposit on the glass which adheres to it and can not easily be removed, or again sometimes results in a sediment which remains suspended in the liquid. In this case it is very difficult to improve the wine or remove the sediment, and the only means is to open the bottles and add a small amount of sizing and pure tannin, which will cause the formation of the granular sediment.

Removal of Lees and Rebottling.—The deposit which has accumulated on the cork is removed by taking the bottle carefully in hand without agitating or reversing it, and by a suitable machine removing the clasp which retains the cork, when the latter will be immediately forced out with an explosion by the pressure of the gas, and with it will be forced out the deposit which will have accumulated on the cork. At the moment this occurs, the workmen dexterously turns the bottle up, so that the liquid is not lost, and closes it with a temporary cork.

The wine in its present condition, however, is not by any means perfect. It is much too acid and is sometimes astringent, and to be rendered suitable for the consumer the addition is made at this point of a certain amount of sugar dissolved in an old and excellent wine which is free from germs of fermentation and carefully filtered. This serves to ameliorate the wine and also make up the loss occasioned in removing the deposit. The amount of sugar is not limited by the amount of loss following the removal of the cork, but is determined in advance for each brand of wine, and when necessary an additional amount of wine is removed to allow of the introduction of a larger amount of sugar. This is one of the steps in which no definite rule can be given and in which experience alone will teach the proper amount to use. Its importance, however, is very great, as on this addition will depend very largely the character of the finished product. The bottle is then carefully recorked with a new cork, which usually bears the stamp of the château and is fixed in place as before. The bottle and cork, however, are now ornamented and labeled as seen in the market.

For the wines of the province of Champagne the bottles are of special quality and are made at a limited number of glass works in the departments of Marne and Aisne. The corks are obtained from Spain. The sugar used in the additions to the wine is obtained from cane grown in the neighborhood of Mantz, where the manufacture of the pure article has been followed from time immemorial. One of the chief exhibits at the Exposition was that by the Syndicat du Commerce des Vins de Champagne, which includes a large number of the more important vineyards of that ancient province.

Champagne wines may be preserved for a long time on the condition that as soon as the bottles are received they be stored in a cool, fresh cellar. Before being used they should be allowed to rest for fifteen days or three weeks.

RAISIN WINE.—Owing to the ravages of the Phylloxera and of various cryptogamic diseases which have greatly reduced the grape crop of France, the manufacture of wine from dried grapes—currants or raisins—has now assumed considerable proportions. It has caused France to become the chief consumer of the vine products of other countries, and to rely on foreign countries, particularly the fertile regions of the Levant, and also to some extent on the vineyards of California for the material for the manufacture of this kind of wine, the annual consumption of which has reached several million hectoliters. The production of this sort of wine is not, as commonly supposed, of French origin, but has been practiced from time to time in almost every vine-growing country. Hitherto, however, it has been produced only in small amounts and as a temporary expedient, and it has never attained the proportions it now exhibits in France.

The subject of making wine from dried grapes has given rise to lengthy discussions as to the merits of the product, but the conservative opinion seems to be that if the manufacturer is content merely to supply the amount of water lost by drying, so as to bring the grape back to its normal condition, a special alcoholic wine can be produced which is similar in composition with that made from the fresh grapes. The fermentation is, however, not perfect, and the wine produced is necessarily of inferior quality and is similar in composition to second wine. If, however, the addition of water is in excess of the natural amount found in the grapes (and the temptation to do this is frequently present, owing to the extreme richness in sugar of the currant or raisins) artificial wine is produced which is necessarily inferior to the wine produced by the addition of the normal quantity of water in all the elements except the percentage of alcohol.

The dried grapes for this purpose are very largely obtained from the Morea and the Ionian islands, and are chiefly the product of the famous black Corinthian grape, known in the markets of the world as currants (corruption of Corinth). The Corinthian grape is small and seedless, growing in small compact bunches, and has been introduced into California, bnt is not yet grown there in marketable quantities. The method of preparing these grapes for market is interesting. They ripen from the 20th of July to the 18th of August, but are not gathered from the vines until from the last of August to the middle of September. The gathering is done by women and children in large baskets and the grapes are carried to large rectangular earthen floors or elevated areas which are slightly inclined to allow the rain to run off freely. The surface of these tables or elevated sun-drying floors is plastered over with fresh cow dung or dung mixed with water, which hardens and furnishes a smooth surface almost free from odor. The grapes are spread

out on the surface of these platforms and allowed to remain there day and night, care being taken to turn them over every 24 hours. In a fair season they will dry in eight or ten days; but in a rainy season from twenty to thirty days will often be necessary, and, if the rains are very excessive, the crop is frequently lost. The dried raisins are carefully separated from the stems, cleaned, all foreign bodies removed, and then stored in buildings specially constructed. These are hermetically closed, except for an opening above, through which the currants are introduced, and one at the bottom from which they are extracted for shipping, and which is never opened except when they are to be removed for this purpose. The currants introduced through the upper opening of the structure are compressed by their own weight and also artificially, until eventually they form a solid mass which holds together very firmly by the escape of a viscous liquid. In removing them for transport to foreign markets it is necessary to use an iron prod to detach pieces from the mass, and these pieces are packed in small barrels and compressed into a solid mass by tramping with feet, which compression serves to protect them from the exterior air and allows of their being transported in excellent condition to all parts of the world. The production of currants from this grape in the regions named is in the neighborhood of twenty million pounds annually, of which less than one-fifth is used for home consumption, the balance being exported to England, France, the United States, etc.

Dried grapes or raisins are also obtained in large quantities from Asia Minor, where both the black and the white grapes are employed; Malaga on the south coast of Spain, and Valencia on the east coast; and in smaller quantities from Italy, California, and Chile.*

The Method of making Wine from dried Grapes.—In the manufacture of wine from dried grapes the same methods and processes are followed as in ordinary wine-making, except that owing to the different conditions some slight variations are made and greater precautions have to be taken. After being removed from the sacks or barrels in which they have been packed, the raisins are broken up into small lots and carefully examined, all moldy, fermented, or insect-injured grapes being removed. The water added to the raisins to make up for the amount lost by evaporation should be pure and not charged with foreign salts, particularly bicarbonate or sulphate of lime, which will retard the fermentation and give rise to very disagreeable odors.

**Raisin product for* 1889.

	Tons.		Tons.
Greece	125,000	California	10,000
Smyrna	120,000	Malaga	8,000
Valencia	28,000	Scattering (about)	10,000
Italy	15,000		

Rain or spring water, particularly water coming from gravelly or granitic soils, is preferable. The raisins are placed in a vat of water, in the proportions of 100 or 150 liters of water to 100 kilograms of raisins. In from thirty-six to seventy hours afterwards, according to the temperature, the raisins will have regained their natural form and size, and will have softened sufficiently to be easily crushed. This operation is of very considerable importance, as it is necessary to have each grape broken open in order to permit its contents to be easily and completely acted upon by fermentation. If this is not done, the action of fermentation will be slower, and there will be a loss, owing to the failure of all the contents of the berries to be transformed by fermentation. The amount of water to be added to the raisins has been determined by careful analysis and will vary with the percentage of alcohol which it is desired to have in the wine. After crushing, the grapes and liquor are introduced into large vats to undergo fermentation and constitute a must analogous to the true must of the fresh grape. It is sometimes necessary to heat the must to accelerate the fermentation, or it is advisable to introduce into the must some wine in an active state of fermentation, if any such be accessible, which will start the action of fermentation at once. The collection of the solid part of the must on the surface of the liquor, forming a cap or chapeau, should be prevented by some of the means described in the early part of this article, and the action of fermentation should be carefully measured from time to time by the aid of the thermometer and glucometer. After the action of the ferment has ceased, the wine is racked off very carefully, the marc is pressed, and the product added to the racked wine after having been clarified independently. The racking is repeated after a few days, and if, after standing for a long time, the liquid is not sufficiently clarified, it is treated with finings until perfect limpidity is secured. The wine thus produced, while a palatable and wholesome drink, can not be classed with the wine produced from the natural grape, and strict laws have been enacted in France to prevent its sale except under its true character. Unfortunately these laws do not protect other countries, and the raisin wines exported often do not bear any indication of their true character. A partial protection to the consumers from deceit in this matter comes from the activity of the producers of native grape wines in France, the reputation of whose products is necessarily injured by the placing on the market of these inferior wines as true products of French soil.

SECONDARY PRODUCTS OF THE GRAPE.

Uses of the Husks and Lees.—From the husks and lees a number of valuable products are obtained. These are the *piquettes*, sour wines, the second wines, or *vins de marcs*, and, by distillation, brandies

and tartar. They are also afterwards employed as fertilizers and as food for animals. These products will be very briefly referred to.

Second Wines, or Vins de Marcs.—The husks, after pressing, still contain a considerable quantity of liquid estimated at from one-fifth to one-fourth of the total product, and also tannin, sugar, and more or less coloring matter and other principles not completely removed by the first fermentation.

In the manufacture of second wines, water to the amount of half the wine already drawn off is added to the husks, which have been replaced in *cuves*, or fermentation vats, and sufficient sugar to give from 7 to 8 per cent of alcohol. It is advisable to first dissolve the sugar in the water, raising the latter to a temperature of from 33° to 35° C. to facilitate fermentation. The tartaric acid and tannin is sometimes in too small quantity in the second wines, and it is customary to add to the *cuve* from 25 to 30 grams of the first, and 5 to 8 grams of the second for each hectoliter of the second wine. The following treatment is as in the manufacture of the first wines.

With very highly-colored grapes third and even fourth wines are made, larger and larger quantities of tannin and tartaric acid, however, being required.

By mixing the second wines with coarse and highly-colored first wines, such as those produced from the American grapes, Jacquez and Cynthiana, a very fair cheap wine is obtained, which, if sold under its proper designation, may be recommended.

Piquettes.—These cheap but slightly alcoholic sour wines are obtained by adding pure water to the husks or marc, either before or after pressing. In the former case the product will contain the press wine, and be consequently of a higher grade. The manufacture of *piquettes* is very simple. A cask is filled and pressed tightly with the marc, the head is then replaced, and water is introduced at the bung until the cask is completely filled, when the bung is closed. In the course of time a light wine having 3 to 4 per cent of alcohol is produced, which does not keep long, but which furnishes a cheap and very healthful beverage. Piquettes are improved by mixing with other wines, or brandy is obtained from them by distillation.

Brandies.—Brandies are obtained either by distilling the marc direct or by the distillation of piquettes. The former method results in a brandy of rather disagreeable taste, the latter in a very palatable drink. The quantity of brandy is often increased by adding sugar to the marc in the *cuve.*

The marc from which white wine has been made is richer in the desirable elements, and is especially valuable for the manufacture of brandies or second wines. It enters rapidly into fermentation, and produces an excellent brandy.

The disagreeable taste attaching to brandies distilled directly from the marc limits somewhat this method of manufacture.

One of the latest improved stills or alembics and the process of distillation may be briefly described as follows:

The Deroy still (Fig. 190) comprises in the main; a copper boiler in which the marc with a small quantity of water is placed; a furnace, 14, a reservoir, 3, in which the alcoholic vapors are received and from which they pass into the worm 7, where they are condensed by means of cold water in the surrounding reservoir 8. The minute features of the apparatus need not be described in this place. The stills are either stationary or mounted on wheels to facilitate their transportation from place to place.

In the distillation of piquettes, the apparatus and methods are practically the same as in the case of the distillation of marc direct;

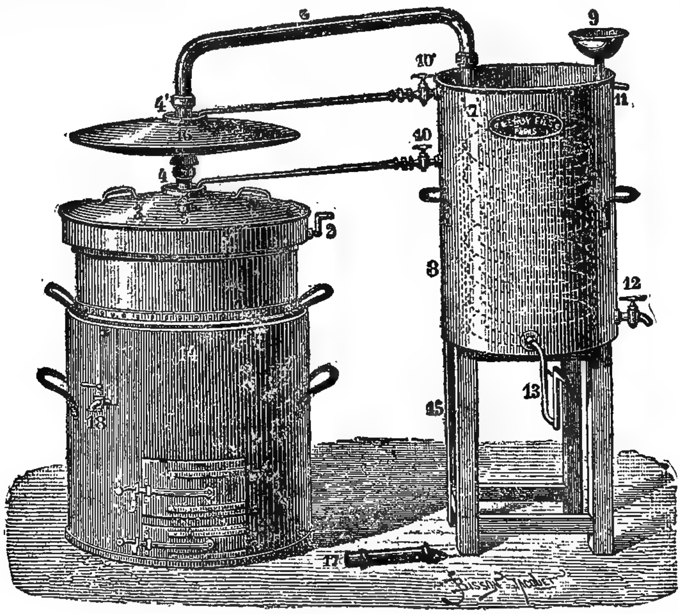


FIG. 190—The Deroy still or alembic. (From Rougier.)

the operation, however, is continuous, it not being necessary to check it to empty and refill the boiler or vat.*

Tartar.—The tartar, a combination of potassium bitartrate and other matters, is obtained or dissolved from the marc, after the alcohol has all been drawn off, by filling the boiler 1 (Fig. 190) with water and causing the mixture to boil slowly for an hour or less. The boiling water is drawn off into vessels and on cooling the tartar crystallizes out. From 1 to 1½ kilos of crystallized tartar are obtained per hectoliter of marc. From the crude tartar thus obtained is

* Since this was in type the subject of brandy distillation has received very thorough treatment in Appendix A of the Biennial Report of the State Viticultural Commissioners of California for 1891–'92, which includes, also, a translation of Antonio Dal Piaz's work on cognac manufacture, which is one of the best of the foreign treatises on the subject.

manufactured potassium bitartrate or "cream tartar," and also tartaric acid.

The Husks or Marc as Fertilizers and Food.—As food the marc is mixed with oats or other grain and fed to cattle, horses, and particularly sheep. It is either fed out at once or preserved as ensilage.

As a fertilizer, the marc is mixed with other manure, to form composts, and is supposed to be especially valuable as an application to vine lands by returning to the soil the elements extracted by the grape.

THE WINE ESTATE OR CHÂTEAU.

One of the first subjects that will impress the student of French wine making are the almost innumerable houses or châteaux in celebrated wine districts, each bearing a distinctive name which brands its output of wine.

An idea of the character of these places will be obtained from the following brief reference to the region of the Gironde, including the districts about Bordeaux, which is beyond question the most famous wine region of France. Bordeaux is situated on the Garonne, and is a city of considerable manufacturing and commercial importance, but these interests are small compared with its trade in wines, and in the stores where wine is handled and in the cellars where it is placed centers the real business of the city. The department of the Gironde occupies an area of more than 2,500,000 acres, about one-fifth of which is planted to vines. The vineyards extend along the banks of the Gironde and Garonne rivers, and according to their situation or the nature of the soil the wines of the Bordelais are classed and generally known as the wines of the Cotes, Graves, Palus, Entre-deux-Mers, etc. In this territory the most famous is the Médoc district, which stretches from Bordeaux to the sea in one direction and lies between the rivers and the district known as the Landes. It comprises a small tongue of land, which is almost a peninsula and which is entirely planted to vines, and along the river for a distance of 40 miles and an average of 5 or 6 miles in width nothing is met with but vineyards. These are separated into small communes, each of which bears some ancient or celebrated name, as Margaux, St. Julien, etc., but in some cases these communes are of considerable extent and comprise distinct and well-known brands of wine, each the production of a distinct house. In this way the Margaux commune includes a large number of châteaux, and this condition of affairs results very frequently in erroneously ascribing all the wines from this commune to a particular château included in it bearing the same name, whereas there are half a dozen other equally important houses.*

* A point may be mentioned here which is not generally considered by foreign purchasers, namely, the taking the brand of a wine as an index of its quality. For instance, the clarets produced by a particular house in different years will vary in price from $30 to $300 per hogshead, the difference depending on the success or nonsuccess of the vintage of the different years.

The great majority of the châteaux in Médoc are simple country seats, often of no very great importance, in which the proprietor resides from time to time, and generally only during the vintage. The wines as they are quoted in the market usually bear the name of some château or other, and the fame of some of these places has become world-wide. Formerly the term château was applied to one of the old manorial residences and a resemblance to the old condition of affairs is still maintained in many cases by the antiquity of the buildings and the baronial style of architecture. Others are constructed in more modern style. The cultivation of the vineyards which cover the hillside surrounding the house or castle is accomplished chiefly by means of oxen, horses, however, being also employed; and the more delicate work of the vineyards, such as the pruning and care of the vines during fruitage, and the destruction of the various insect pests, is done by women, who, in their neat dresses, present a very picturesque appearance in the vineyards. All the laborers, cattle, horses, etc., employed in the vineyards are accommodated in small outbuildings adjoining the château, about which also are ranged the press houses and cellars in which the wines, after being drawn from the hogsheads, are placed for permanent keeping. Some of these cellars are of immense size and the long rows of hogsheads in them present an imposing spectacle. In them the wine is bottled and stoppered with a special cork bearing the name of the château. In these cellars the best wines are kept for long periods to develop the special qualities coming only from age, which give them their reputation.

To develop similar distinctive qualities should be the ambition of our American wine-makers, and this will not be attained until our best types are properly stored as they are in France, long enough to become thoroughly ripened and developed.

CHAPTER VII.

CLASS 76.—USEFUL AND INJURIOUS INSECTS.

BY C. L. MARLATT.

Bees and silkworms.
Cochineal insects.
Apparatus used in the culture and keeping of bees and silkworms.
Apparatus and methods used in the destruction of injurious insects.

I.—SERICICULTURE.

The number of persons engaged in producing silkworm eggs or the amount of eggs produced is not so good a criterion of real progress in sericiculture as is the average number of kilos of cocoons produced by an ounce* of eggs.

In France this yield has increased from 13.4 kilos per ounce in 1862 to 36.4 kilos in 1888, though during the time there was a decrease in the amount of eggs hatched, one factor having increased while the other diminished. The total yield has remained nearly constant, as the following table will show:

Year.	Ounces of eggs hatched.	Average yield per ounce.	Total yield of cocoons.
			Kilos.
1862	724,922	13.4	9,758,804
1872	809,581	12.2	9,871,116
1882	342,720	27.9	9,690,464
1888	264,710	36.4	9,549,906

In 1874 the competition of Eastern silk arriving via the Suez Canal caused a ruinous fall of prices throughout Europe, and in France a kilo of cocoons, which from 1862 to 1874 brought 6.70 francs, would thereafter only bring 5 francs, which price gradually fell to 3.50 francs in 1888. The consequent loss to silkworm raisers was very great, so that while in 1872 there were 200,000 families supported by this industry in 1888 this number had fallen to 143,000. Another reason for this decrease is that the new process of breeding requires careful education and training, which many persons are too poor, too busy, or too ignorant to acquire.

*An ounce of silkworm eggs weighs 25 grams in the department of Basses Alpes, but 30 grams elsewhere in France.

Japanese silkworm eggs were first imported into France in 1864, and soon supplanted the eggs of native races to such an extent that in 1869 they formed 70 per cent of the whole. In 1872 this proportion had decreased to 61 per cent, and in 1882 to less than 4 per cent, this last diminution being caused by the rehabilitation of the native races through Pasteur's system, which has proved to be the salvation of French sericiculture. In 1883 France again commenced to export silkworm eggs, about 200,000 ounces being yearly sent to Turkey, Greece, Hungary, Spain, and Italy.

In 1857 the mulberry trees of France afforded 600,000 tonnes of leaves annually; but, the trees having been neglected, many have perished, so that at the present time it would be difficult to procure 250,000 tonnes.

In short, France does not now produce as many silkworms, and has not as many mulberry trees as formerly, though she produces proportionately more cocoons, and the eggs produced are of better quality. The benefits, however, which arise from this intensive culture do not counterbalance the loss resulting from the decrease of the industry.

There were some twenty exhibits made by French sericiculturists, foremost among whom should be mentioned the late M. Eugène Mailot, director of the sericicultural station at Montpellier. He displayed a large sericicultural map of France, and has also issued (1886) a pamphlet giving statistics of this industry. It is to his notes, used before the International Agricultural Congress and those made by Prof. Riley and Mr. Amory Austin that I am indebted for much important data in preparing this report.

From Maillot's statistical tables it is shown that during the three years 1882–'84 silkworms were raised in 24 of the departments of France. Of these departments, Gard, Ardèche Drôme, and Vaucluse were the most important, in order, and together raised over 80 per cent of the total amount of silkworms, while six other departments each raised from 100,000 to 300,000 kilos of cocoons, the remaining 10 departments being less important in this respect. The average annual product of the whole of France during these three years was 7,936,215 kilos of cocoons, of which 260,000 were green cocoons of foreign origin.

Department.	Number of silkworm raisers.	Number of ounces raised.	Yield per ounce.	Total product of cocoons.
			Kilos.	
Gard	33,610	86,643	26.3	2,255,978
Ardèche	31,134	73,166	22.4	1,642,326
Drôme	35,172	61,179	24.9	1,524,225
Vaucluse	25,582	44,240	25.1	1,112,156
Var	4,872	9,276	39.7	368,445
Isère	8,999	12,223	23.7	290,554
Bouches-du-Rhône	5,588	9,352	20.6	193,162
Hérault	2,355	5,761	28.7	165,389
Basses Alpes	2,471	3,119	32.5	101,394
Lozère	2,312	5,336	17.8	95,518

There are four departments in which the production of silkworm eggs is more important than the production of cocoons, namely Var, Basses Alpes, Corsica, and Pyrénées Orientales. A comparative table is here given.

Department.	Eggs raised annually.		Yield per ounce.	
	1857–'62.	1883–'85.	1857–'62.	1882–'85.
	Ounces.	*Ounces.*	*Kilos.*	*Kilos.*
Var	12,307	9,276	20 30	39.70
B. Alpes	3,346	3,119	18.33	32.50
Corsica	327	855	28.70	41.60
Pyrénées Orientales	14	474	21 12	48.50

According to statistics published by the syndicate of silk merchants of Lyons the average annual quantity of raw silk brought to European markets in 1882–'84 was :

	Kilos.
France	622,000
Italy	2,793,000
Austria-Hungary	149,000
Spain	96,000
Turkey and Greece (the Levant)	518,300
Georgia and Persia	233,300
China	3,282,600
Japan	1,491,600
India	400,000
Total	9,586,400

M. Chauvet, of Buis (Drôme), displayed an interesting collection of cocoons of various races, and also those resulting from the cross-breeding between the Gros-Var and Gros Riom races, Var and Bagdad.

M. Forné, of Céret (Pyrénées Orientales), showed cocoons and eggs of various races, among others the large cocoons of the Fossombrone race, which are used especially in making the product known as *cru de Florence.*

The exhibit of M. Fallou, of Paris, was devoted to exotic races and was incomparably better than any other showing in the same class. M. Fallou has for years and with remarkable patience conducted experiments in sericiculture, in the effort to discover and introduce new races and species of silk insects. Three among these only have proved of any practical value in French industry, namely, the *Attacus cynthia,* from China, and the *Antheræa pernyi,* also from China, and the *Attacus yamamaï,* from Japan.

The first of these, *A. cynthia,* has become so well acclimated in France that it has almost reverted to the wild state, and may be found upon the Ailanthus trees in public parks or along the avenues in cities, just as in the United States. It was also shown at the Exposition of 1878, but its open cocoon renders it difficult of use, not-

withstanding M. LeDoux's ingenious process of winding such cocoons, so that it may be considered as lost to French industry.

The bivoltinism of the *Antheræa* offers a serious obstacle to its acclimatization in France, since the falling of the leaves from the oak trees does not always allow time for the complete development of the second generation.

This disadvantage does not exist in the case of *Attacus yamamaï* the silk of which is of a very superior quality and was also exhibited in France as early as 1878. Although, perhaps, practice and experience will bring better results, the breeding of this species, as well as that of the others, will probably remain in the hands of amateurs.

M. Fallou has succeeded in raising certain races, notably the *Antheræa, Telea polyphemus, Attacus ceropia,* etc., in the open air at his nurseries in Seine-et-Oise.

The other French exhibits consisted of eggs, cocoons, etc., of native races, large anatomical models of silkworms, raw silk, etc., the whole making a moderately large and interesting display.

ALGERIA.

Hardly any attention whatever is given to sericiculture in this country, although silkworms do remarkably well throughout the Tell. The production is, however, increasing, and from 1875 to 1880 the increase in the total amount of cocoons was from 5,300 to 139,-000 kilos. There were five exhibitors from Algeria showing cocoons and eggs produced by the cellular system. The races of Algeria have no special characteristics, but are derived from French races.

ITALY.

There was but a single exhibitor from this country, Sig. Marconi, of Cremona, who showed new apparatus for producing eggs by the cellular system devised by Pasteur. His method consists of using small bags of perforated parchment or paper, or of small boxes covered with gauze, and does not seem to present any particular advantages over the bags of gauze ordinarily employed.

Italy stands incontestably at the head of all the European states in sericiculture, as the following figures show:

	Kilos of cocoons.
1879	18,546,546
1880	41,674,109
1881	37,837,661
1882	31,628,112

The importance of this production is due, not only to the extent of breeding, but to the perfection of the methods in use; the principles of cellular breeding are vigorously applied and the yield of sound eggs is considerable in consequence.

The following shows the kilos of cocoons per each ounce of eggs, the ounce weighing 28 grams:

1878	15.3
1882	23.7
1883	29.0

In 1883 the yield in kilos of cocoons per ounce of eggs in certain provinces was as follows:

Pesaro	59.9
Ancona	54.9
Macerata	48.4

In Italy the only variety of silkworm formerly raised was that with yellow cocoons, but during the prevalence of the silkworm disease eggs of the Japanese race having green cocoons were introduced. At present native races are preferred, and their use has greatly increased in the last few years. The following shows the per cent of yellow or native cocoons:

1878	11.9
1879	29.3
1880	26.8
1882	34.5
1883	41.1

OTHER EUROPEAN COUNTRIES.

Belgium sent one exhibit, that of Mme. Fuisseau of Brussels, who showed cocoons, apparatus for rearing silkworms, material for teaching the art, and several books and pamphlets upon the subject. No new facts were brought out by this exhibit, which was similar to that made in 1878. The Belgian Government has for many years attempted to encourage sericiculture, but without success, and the industry is practically of no importance in that country.

Great Britain exhibited a few cocoons from Cashmere. The other European States made no exhibits whatever in sericiculture. A table of their average annual production is, however, here given:

	Kilos.
Austria-Hungary	2,560,000
Turkey in Europe	1,500,000
Spain	1,300,000
Greece	300,000
Portugal	250,000
Switzerland	210,000
Roumania, Bulgaria, etc	170,000
Russia in Europe	120.000

JAPAN.

This country made a most interesting exhibit of its silk-culture under the auspices of the minister of agriculture and commerce and of the agricultural and forestry school at Komaba.

About 30 races of the silkworm, *Sericaria mori*, are common in

Japan and a complete collection of these and of other silk-producing lepidoptera was exhibited. Among all these the following races of the true silkworm may be mentioned:

Maroumota, the smallest of the Japanese races and very much preferred for breeding.

Aobiki, very commonly cultivated.

Matamoukashi, Himeko, Koïshimarou and *Akajikono*. These are all spring races, with small white cocoons. The *Akajikono* race produces large white cocoons and the *Koriu* is the only race having a yellow cocoon. This latter race is now practically abandoned by Japanese silk-raisers.

There are also five bivoltine races, among which is the *Koumako*, the worm of which is black. The *Sikerasei* race is quadrivoltine.

Other silk-producing Lepidoptera may be mentioned as follows:

Antheræa or *Bombyx yamamai*. The larva hatches in mid April and spins its cocoon toward the end of June, the moth making its appearance toward the first of September; feeds upon oak, etc., and affords a good quality of silk.

Caligula japonica (Moore). Feeds upon the chestnut. It has a loosely woven, open-work, decussate cocoon (*cocon treillissé*) and affords a fair quality of silk.

Caligula janasi (Butler.). Polyphagous; affords fair silk.

Rhodia fugax (Butler.). It spins a green cocoon and furnishes a coarse silk which is used for making fish lines.

Attacus pryeri (Butler.) Bivoltin: the larve hatch at the end of June and also in August. The first generation begins to spin at the end of July, hatches from the cocoon in August, and immediately lays for the second brood, which hatch at the end of August and in turn spin at the end of October, remaining in the cocoon all winter. This silkworm feeds upon the ailanthus and sumac and affords a fair silk.

A characteristic of sericiculture in Japan is the absence of large silkworm nurseries. This is due to the fact that silkworm-raising has remained a domestic industry, and it is probably by this method that the health and vigor of the silkworms are preserved.

The Japanese exhibit also contained illustrations of the different diseases of the silkworm. These, though only too common in Japan, have, nevertheless, not caused such great disasters in that country as they have in Europe.

Among these I may mention a Dipterous parasite, *Ujimyia sericaria* (Rond.), the larva of which infests the body of the silkworm. The parasitic larva when full grown pierces the cocoon of its host and transforms to the adult in April of the year following. On the authority of Prof. C. Sasaki this Dipteron has the very anomalous habit of depositing the egg on the mulberry leaves. The eggs hatch after being eaten by the silkworms. (See *Insect Life*, vol. I, p. 62.) The presence of these larvæ within the silkworm is not ordi-

narily perceptible before the fourth or last molt, when it is shown by the appearance of black spots.

The average annual quantity of cocoons raised in Japan exceeds 20,500,000 kilos. Exportation of cocoons is tending to increase, while that of eggs is tending to diminish, a fact easily accounted for by the advance of silkworm culture in that respect in France and Italy.

From 1883 to 1888 Japan has furnished to Europe an average of 1,577,000 kilograms of raw silk. The average amount furnished by China has been 3,717,200 kilos and that by India 765,800 kilos.

SERICICULTURE IN HUNGARY.*

The first attempts at this industry were made at the end of the seventeenth century, and the first Hungarian filature was erected in 1750 by Gen. Mercy, governor of the Banat.

Sericiculture and the working of raw silk were monopolized by the government until 1788, but this monopoly was found to require a large force of workmen, besides which the cocoons were of poor quality and the raisers of them were poorly paid. The industry therefore steadily failed until its revival by Archduke Joseph in 1840.

The Hungarian custom is that the government sends eggs out to cocoon-raisers and then buys back the cocoons coming from the eggs. In 1826 there were 152,880 kilos of cocoons thus bought back, but the quality was poor and the system was found to be expensive, so that in that year the right of buying back cocoons was ceded for 10 years to the Hofmann family. In 1836 the number of cocoons bought back by this family was 263,000 kilos, and their contract was renewed for another 10 years, with the additional requirement from the government that the family should establish a filature in every district where at least 3,360 kilos of cocoons were to be procured.

In 1838 the exportation of raw silk to Austria amounted to 306,346 florins In 1840 there were 392,000 kilos of raw silk bought back from 32 localities where filatures had been established according to the above proviso. In 1841 this figure had risen to 473,360 kilos.

The Hungarian revolt of 1848 was almost fatal to sericiculture and what was left of it perished from, *pébrine*, so that in 1850 one or two establishments only seemed likely ever to revive. One of these, at Hidja, did revive, however, and was in a flourishing condition in 1889.

In 1872 an inspectorship of sericiculture was established at Szegszard, which continued in active service up to 1879 and had in those seven years bought back 2,507 kilos of cocoons in its region. This inspectorship was reorganized in the spring of 1880, and there was given to it the mission, not to seek great revenue, but rather to introduce sericiculture and to further its development in all favorable localities, and thus to build up a fruitful industry in Hungary. The inspectorship has had a good success and the industry has been advanced thereby. The future of the industry has also been assured by the planting of mulberry trees and by technical education.

In 1888 there were 625 kilos of silkworm eggs derived from the hatching of 5,100 kilos of cocoons. Various quantities of eggs are annually imported from France or Italy for the improvement of native races. In 1888 this importation amounted to 127 kilos.

*From a paper read before the Agricultural Congress by M. Paul Bézérédj.

Eggs are cultivated after Pasteur's system at Szegszard, and are thence sent for free distribution all over the country. Not a single egg is sold.

Up to 1889 cocoons were bought back from those who raised them at 1.20 florin for first sorts and 50 kreutzers (about 24 cents) for second sorts. In 1889, however, it was deemed expedient to buy all cocoons at an uniform price of 1 florin. An inspector watches the raising in each commune or hamlet, while there is also a comptroller to every 20 or 25 communes. Many Hungarian cocoons go to Milan or Gorizia.

Sericiculture can not be performed upon a large scale in Hungary; the industry is only advantageous for poor families where there are old men or children who may thus find employment. In fact the labor is extremely easy and only lasts for six weeks or so, and brings to these poor people an acceptable revenue at the moment when it is most needed, *i. e.*, in spring, before there are any crops to be gathered. Wherever this work is to be performed by daily workmen, and not in families, there is no profit.

Silkworm-raisers pay nothing for their mulberry leaves, since the trees are planted along the roadsides and in public places and are placed entirely at their disposition by law.

The future of sericiculture in Hungary depends upon a sufficient supply of mulberry trees. This supply should be a care of the state, and not left to private enterprise.

Municipal decrees, even though timely, are not sufficient to arrive at this result. A law should be made obliging each favorable locality to plant mulberry trees, which should become public property. Nurseries might also be established. It is not sufficient to encourage private planters, for these, not seeing an immediate profit, will not pursue the planting with zeal.

It has been observed throughout Europe that those countries where sericiculture flourishes best are those where the state is the initiator of its adoption.

II—APICULTURE.

At an Exposition held in 1887 at Neuchâtel, in Switzerland, especial attention was given to apiculture. An organization of all the Swiss apicultural societies was made and was presided over by a commissioner who was an expert in apiculture. As a consequence there was a complete exhibit of everything pertaining to this branch of agriculture.

At the Paris Exposition of 1889, a lamentable contrast to the above exhibit was presented. There seems to have been no plan of organization among the French apiculturists, and there was no apicultural exhibit, properly so called. Instruments and products were scattered here and there without order, and the exhibits were few in number, and, with one or two exceptions, were not particularly striking in quality. No good idea of progress in the industry could therefore be formed.

One cause of this state of things was that apiculture was omitted from the programme of the agricultural congress, probably through simple inadvertence. This omission was, however, partially remedied at the eleventh hour by M. de Ribeaucourt, who at one of its meetings expressed his regret that such should have been the case, and gave several illustrations of progress made in apiculture in the

United States and in Switzerland. At the same time he offered a resolution that the ministry of agriculture should take this branch of rural economy under serious consideration and should encourage its development by all possible means, especially by the instituting of peripatetic instruction. This resolution was adopted by the congress, and will at least have the effect of attracting the attention of the Government toward the importance of apiculture.

In the French exhibit most of the hives shown were frame ones, although the old straw and box hives with fixed combs are much more commonly used among the farmers of France. This adherence to the old-fashioned form is one of the signs which show the backwardness of apiculture in France.

As to the proportion between fixed and movable-comb hives, no reliable figures can be given. Nor could the apicultural congress, which met at Paris July 13 to 15, supply these data, and even the ministry of agriculture itself has only approximate figures, the number of hives in France being estimated at something over 2,500,000, a comparatively small proportion of which are frame hives

In presence of these facts it is impossible to more than briefly examine some of the more prominent exhibits. The *Société Centrale d'Apiculture et d'Insectologie* made a collective exhibit of hives, honey in the comb, extracted honey, wax, and accessories. The hives were of the movable-comb type, and one, a double one, was shown containing Carniolan bees upon one side and Italian bees upon the other, and having movable sides and windows for observation. This society was founded in 1856 and has shown considerable zeal in popularizing methods preferable to the ancient systems of bee-keeping, but its conservatism regarding the important improvements and discoveries, upon which apiculture as now practiced in the United States is based, has done much to keep France behind many other countries in this branch. Its organ, the *Journal d'Apiculture*, established in 1857, has a wide circulation.

Mme. la Vicomtesse de Poli exhibited a hive of her own invention and called the "Jeanne d'Arc." This is claimed to present the advantages of both movable and fixed comb hives, and was shown in three different patterns. In the hive for bee-keeping on a large scale the main body is cylindrical and is divided vertically into two parts, and has a hemispherical top also divided into two parts. These four portions of the hive fit together by means of grooves. Ventilation is provided for, and the interior is fitted with twelve movable frames of appropriate form. A small hive intended to be suspended from a tree was also shown. It is perfectly spherical, and is divided along its horizontal diameter.

M. Gariel, of Paris, showed excellent hives of English and American types. In addition there was a collection of wax from different districts of France. *Algeria* had no exhibit in apiculture.

Among the foreign exhibitions of apiculture, that of the United States (see Appendix IV) unquestionably took the first place. The other countries were poorly represented, and, with the exception of Greece, no country presented more than three exhibits, and most of them but a single exhibit each. There was an almost complete absence of data as to methods of culture, the greater part of the exhibitors being content to present samples of hives, honey, or wax without any explanation whatever.

Austria had but one exhibit—viz, that made by Michael Ambrožič, of Moistrana. The principal object in this display was an observation hive, intended to be placed upon a table in a room just before a window, one pane of which is to be cut away so that the opening thus made will just fit the anterior opening of the flight box of the hive. The latter is double, one for each lateral division of the hive, and is so constructed as to allow full observation of the entrance and exit of the bees, and of the amount and quality of the food which they bring home. It also allows of the easy separation of the queens and drones from the working bees at the swarming season, thus preventing the fertilization of queens by undesirable drones. The hive is provided with glass doors which allow unobstructed observation of each comb from either side, and which also permit the instant detection of enemies which may have entered, or of diseases etc. By means of movable brass slides the hives may be divided into two or three compartments, according to the number of queens kept. If there is but one queen the slides may be removed, thus forming but one compartment of the whole. The comb-frames may be easily removed or inserted, and the combs themselves obtained by placing foundation in the frames. A feeding apparatus introduces the requisite amount of food, while the temperature of the interior may be regulated by means of ventilators.

M. Ambrožič also exhibited a drone trap, comb-foundation of pure wax and made on a machine imported from the United States, as well as other useful accessories. He also deals in Carniolan bees.

Belgium had three exhibits of hives and accessories, but nothing in these was particularly worthy of notice. Apiculture has lost much of its importance in Belgium of late years, and whereas there were 140,632 hives in the country in 1866, there were in 1880 only 96,858. The causes of this decrease are to be found in the diminution of certain crops, such as colza and buckwheat, which are much frequented by bees, and also in certain unfavorable climatological conditions during the period above mentioned. Besides this, until very recently, there has been but little progress in the science of bee-keeping in Belgium. Honey and wax are imported from France, England, and the United States, the annual average amounting to 746,000 kilos of honey and 267,000 kilos of wax, having a total value of about 1,450,000 francs. These figures serve to show how large a

field is open to apiculture in that country. It is to be hoped that better acquaintance with improved methods will be made among the rural population, and that apiculture will yet become more prevalent. The Government is endeavoring to promote this industry by organizing practical lectures and by issuing publications.

Great Britain had but one exhibit of apiculture, that of Mr. Thomas B. Blow, of Welwyn, who showed frame hives, comb

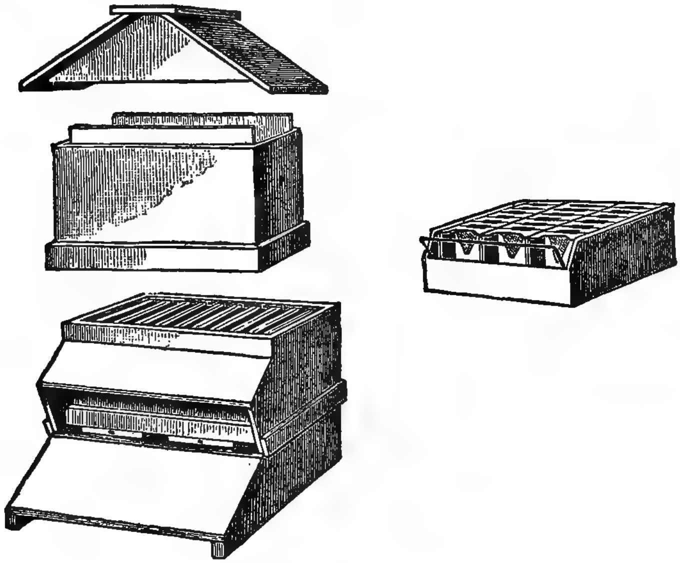


FIG. 191.—Modified Langstroth hive, exhibited by T. B. Blow, Welwyn, Eng.

foundation, extractors, bee-smokers, and other accessories, together with honey and wax. Mr. Blow's factory is said to be one of the largest of the kind in Europe.

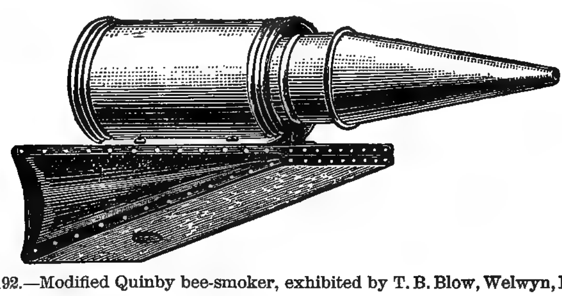


FIG. 192.—Modified Quinby bee-smoker, exhibited by T. B. Blow, Welwyn, Eng.

The hives were all upon the Langstroth movable-comb system and of two patterns, first, those in which the frames run at right angles to the entrance, which are most to be recommended, and, second, those in which the frames are parallel to the entrance. All floor boards were movable and all the hives made of well-seasoned wood. A sample hive is shown at Fig. 191. It has movable combs, double

walls, and two bodies, and is adapted to the system of storifying to obtain extracted honey, or to the tiering system to obtain comb honey in American sections. A bee-smoker, of the Quinby type, which will remain lighted as long as any fuel is left was also shown (Fig. 192).

Greece was represented by 20 exhibitors, each of whom showed honey and nothing else, and all without a single word of explanation or even mention of locality. The honey appeared to be of fine quality.

Luxemburg has an apicultural society, which exhibited hives containing swarms of bees; these hives were upon the most improved modern plan, with movable combs. A fine show of honey and wax was also made.

Three exhibitors from Roumania sent a small but creditable show of hives, some of which were provided with glass plates for observation. Honey and wax were also shown.

Switzerland made but a small exhibit, when it might have made a much larger one. One hive exhibited was provided with iron legs meant to be placed in metallic cups containing water, so as to prevent enemies of the bee from climbing into the hive.

Peripatetic instruction in apiculture, elsewhere mentioned, has proved of immense benefit to the country, and the introduction of American methods into French Switzerland has led to important results for the apiculturists of that section. Some Swiss bee-keepers make a profit of from 3,000 to 4,000 francs annually from their hives.

In the entomological collection exhibited by Japan was one species of bee, *Apis* sp., called *mitsoubatsi* by the Japanese. This bee is domesticated and is also found in a wild state, where it lives in decayed trees or in cavities in the rocks. No exhibit of apiculture, however, was made by the Japanese.

Altogether apiculture seems to have been the weak point of the agricultural exhibit at the Exposition except in the exhibit from the United States, which was much admired, and the extent of which is indicated in Appendix IV.

III.—OTHER USEFUL INSECTS.

Cochineal.—The Argentine Republic and Guatemala had the only displays of cochineal at the Exposition. The constantly increasing use of the aniline and other artificial coloring matters has for many years been gradually but surely driving cochineal, as well as many other dyestuffs, out of the market, so that its cultivation is constantly becoming less; in Algeria, for example, this once flourishing industry has now almost completely disappeared.

Cantharides.—There were two exhibits of this insect in the French section. One consisted of several varieties of cantharides, with the cantharidin extracted from them, while the other showed the insect in all its stages of development, and was accompanied by an

entomological work, giving a full life history of the insect and a chemical description of cantharidin.

IV.—INSECTS INJURIOUS TO AGRICULTURE.

After the Phylloxera, the most important injurious insect of which notice was taken at the Exposition was the locust, which has of late proved so destructive in Algeria. A collection of these, showing the insects in all their various phases, was to be seen in the exhibit of the department of Constantine, together with models of various engines used for their destruction, photographs showing the use of these engines, the collecting of eggs, etc. These locusts have become a veritable scourge in Algeria and extraordinary methods have been taken to destroy them. A tax of 4,000,000 francs was levied for this purpose in 1888, but unfortunately became available only at the time when the locusts, having passed the last stage of their development, die after laying their eggs and so stocking the country for another year. The Algerian authorities also offered to pay for all the locust eggs which might be collected. Although the small price of 75 centimes per decaliter (or 15 cents for 2.64 gallons) was offered, 14,000,000 decaliters were collected and destroyed, and yet this was but a small part of what remained. In April, 1889, the remaining eggs hatched, and would have hatched sooner had it not been for previous heavy rains. Vigorous measures of defense were at once taken by the French Government, and every male inhabitant of Algeria between 18 and 55 years of age was pressed into service. It is a pleasure to record that this requisition was submitted to cheerfully and without complaint by the Algerines.

Various methods of destruction were resorted to. At first the newly hatched locusts were destroyed by beating the ground with branches of trees in leaf, but when their numbers became so large as to render this impracticable the *Melhafa*, the Cypriote machine, and other engines were used. The *Melhafa* consists of a cloth 5 by 2 meters (16.4 by 6.6 feet) in size, which is set edgewise upon the ground and folded at an obtuse angle. The locusts are then driven towards the cloth, which is folded over them, when they are crushed, thrown into pits and covered with quicklime.

The Cypriote machine is of English invention, and comes, as its name implies, from Cyprus. Its principle is the same as that of the *Melhafa*, but its construction is somewhat different. It consists of a band of linen about 1 meter broad and 50 meters or more in length. This is set upright on the ground, and to its upper edge is fastened a band of waxed linen 10 centimeters (almost 4 inches) wide, which is folded over so as to make a right angle to the main surface of the band. Several of these bands may be joined and spread along the ground in the shape of a letter V, extending sometimes to the

distance of 1,200 meters, or three-fourths of a mile, with the opening turned toward the insects. Inside the angle ditches are dug. The drivers then form a semicircle at the mouth of the V and drive the locusts toward its apex. The locusts alight upon the cloth, but are unable to traverse the waxed linen edge and so fall back into the ditches, where they are destroyed. These methods are crude at best, especially when compared with the more practicable measures employed in the United States against the Rocky Mountain locusts, and described in the first and second reports of the United States Entomological Commission.

The locust which causes this destruction is not the ordinary *Œdipoda migratoria*, though this is plentifully found in Algeria, but is a native species, *Stauronotus maroccanus*, which breeds yearly in Algeria and in the center of Africa.

Insecticide apparatus, etc., has been described under Class 75 in connection with viticulture, or in the section following on the Phylloxera (see Chapter v).

COLLECTIONS OF INSECTS—GENERAL AND ECONOMIC.—An examination of the insect exhibits on the Champ de Mars at once revealed the absence of any important scientific systematic collections, and this is what would naturally have been expected. The general public take little if any interest except in showy or instructive exhibits, and the specialist cares little for a collection which he is unable to examine closely and minutely, and furthermore does not care to expose his private collection to the fading action of the light in glass-covered cases.

One would naturally expect at such an exhibit rather representations of the more popular features of the science, particularly in its economic applications, such as exhibits of the life-history and means against injurious insects and of the interesting facts and materials relating to useful species, as in apiculture and sericiculture, already treated of at length. Exhibits of this nature were in fact numerous, and in a few instances were valuable and instructive.

Another group of exhibits was abundantly represented at the Exposition, viz, those showing faunal and local distribution of insects of various foreign countries. In many cases, however, the specimens contained in these exhibits were not at all or incorrectly determined, and the value of the exhibit was thereby greatly reduced.

The exhibits in general entomology, aside from those already mentioned, consisted of (1) publications, (2) illustrations of insects, (3) general collection of injurious species, and (4) faunal exhibits from divers countries. The publications exhibited comprised the various leading French entomological journals and other French publications containing entomological matter.

In the second category Dr. H. Beauregard exhibited a very interesting and scientifically accurate series of representations of the curi-

ous and anomalous life-history of the Blister-beetles, based on original researches. The collection was one of the most instructive to the entomologist, and was accompanied by a memoir which Dr. Riley has noticed in *Insect Life* (Vol. III, p. 3).

Among the French exhibitors also, M. E. Renault, of Choumènt (Haute Marne), displayed an iconography of Lepidoptera, each species being represented both in the imago and larval state, together with specimens of the plant upon which it preys, all beautifully and faithfully done from life in water color and occupying nine large volumes.

Dr. E. L. Trouessart, of Paris, showed microscopic preparations of Acarians, accompanied with interesting illustrations.

In the building devoted to the French colonies, M. Fulcones exhibited some very artistic water colors representing the Lepidoptera, Arachnida, and Crustacea of Martinique; and M. Hue exhibited a series of illustrations of insects of all orders pertaining to French Soudan.

Of general and economic collections a very large number of exhibits were made in the French section by various schools and individuals, relating chiefly to insects injurious to the vine and other fruits and to forest trees. These can not be mentioned in detail.

In this connection may be mentioned, however, the exhibit of the Forestry Administration, in its magnificent pavilion, of the insect enemies of various forest trees—those appertaining to each species of tree arranged in a separate case.

The faunal exhibits referred to may be disposed of by enumerating alphabetically the provinces and countries represented, with a brief description of the nature of the exhibit. I have followed in this, in the main, the account given by Mr. Albert Léveillé.

In most cases the exhibits were fragmentary and poorly determined.

ARGENTINE REPUBLIC.—A few Coleoptera, Hemiptera, and Arachnids.

BRAZIL.—A beautiful collection of Coleoptera, containing many rare species, exhibited by M. Gounelle.

BOLIVIA.—A poor collection of Lepidoptera and Coleoptera, badly determined.

DUTCH COLONIES.—A few Lepidoptera.

ENGLISH COLONIES.—Nine large cases of the insects of Australia. These had unfortunately suffered considerable damage during shipment.

FRENCH COLONIES.—

(1) *Algeria.*—Locust exhibit, with methods of destruction already referred to.

(2) *Camboge, etc.*—Seven cases of Coleoptera.

(3) *Congo.*—Six boxes of Hemiptera, Lepidoptera, and Arachnida.

(4) *Foute-Djallon.*—Two cases of poorly determined insects.

(5) *Guadeloupe.*—The showing of this colony was one of the best made, and consisted of a very carefully prepared and determined collection of a general character of the insects of Guadeloupe.

(6) *Cayenne.*—A number of very creditable collections, but unfortunately to a large extent undetermined.

(7) *French Indies.*—Ten cases of insects of all orders, undetermined.

(8) *Madagascar.*—A few insects and several volumes of a work on Madagascar by M. A. Grandidier.

(9) *Martinique.*—A few insects and a collection of crustaceans.

(10) *Senegal.*—Five boxes of determined insects.

(11) *Tunis.*—A few poorly determined insects and some material appertaining to sericiculture.

GUATEMALA.—One of the most complete collections of Coleoptera of all the exhibits in this order. The naturalist traveller, M. Boucard, who formed it, did not limit the collection to the Coleoptera of Guatemala, but rather made it a collection of the beetle fauna of Central America.

JAPAN.—The entomological exhibit made by the Japanese minister of agriculture and of commerce was most complete, though not very large. Besides the various silk-worms already noticed most of the important insects of Japan were represented, accompanied by clear and succinct notes. Among the Coleoptera in this collection we may notice *Cybister japonicus* (Sharp) and *Hydaticus bowringi* (Clark), which inhabit ponds and marshes, and live upon aquatic plants and animalculæ. The natives of the mountainous regions use them as food when in the larval and imago state. The *Camamousi* (*Chrysochroa elegans*) is much used by Japanese ladies for ornamental purposes. The *Luciola vitticollis* and *L. picticollis* (Keiseun) are luminous. The *Sitophilus oryzae* causes great damage among the rice-granaries of Japan.

Among the Hymenoptera a *Pimpla* (sp. ?) exists as a parasite upon the silk-worm (*Attacus pryeri*) previously mentioned.

Many Japanese Hemiptera do great damage to the rice-plantations. They belong to the genera *Eusarcoris*, *Acanthosoma* and *Coremelæna*. No specific names were given in the catalogue.

Among the Orthoptera the *Pachytylus japonicus* or *Ko* migrates in dense swarms, similar to those formed by the Rocky Mountain locust or the locusts in Algeria. They fly at great elevations and even over the tops of mountains, obscuring the sunlight by their numbers. They attack grasses, or when these fail they will attack any plant whatever, causing immense damage.

MEXICO.—A few articulates.

NICARAGUA.—A few Lepidoptera and Crustaceans.

PORTUGAL.—Seventeen cases of insects of all orders, not determined.

SPAIN.—Two collections; the first, that of M. Sauz of Diego, comprising about 2,000 species of Coleoptera, fairly well determined; and the second collection a number of cases of undetermined insects.

VENEZUELA.—Two cases of insects undetermined.

In concluding the account of this section it may be said that the awards and prizes went almost altogether to French exhibits, except the *Grand Prix*, which was awarded to Prof. C. V. Riley for the general exhibit in economic entomology already referred to, and which was acknowledged by all to be by far the best of its nature shown at the Exposition. (See list, Appendix IV.)

V.—THE GRAPE-VINE PHYLLOXERA.

(*Phylloxera vastatrix* Planchon.)

Of the injurious insects of France, particular attention was given at the Exposition only to the Phylloxera, and, compared with this great vine scourge, the attacks in France of other insects are insignificant. The exhibit of apparatus and methods employed in the destruction of injurious insects related almost exclusively to the Phylloxera, and this last section (V) of Class 76 comprises a brief description of the more practical of the remedies employed against this pest, other than the use of resistant American stocks, which is fully treated in Class 75 (Chapter v).

History of the Phylloxera.—A brief résumé of the history of this insect may not be out of place.

Dr. Asa Fitch, in 1854, described for the first time from the State of New York, this Phylloxera under the name *Pemphigus vitifoliæ,* discovering, however, only the wingless leaf-gall form. In 1867 Dr. Henry Shimer found both the apterous gall form and also the winged insect in Illinois, and created for it the genus *Dactylosphera.* His winged specimens were found in the galls, and, as Dr. Riley has since pointed out, they had in all probability strayed by accident from the roots, as the gall form has not been known since to produce winged specimens. In 1863 the gall form was found by J. O. Westwood, near London, and he also discovered the root form. A few years later, 1867–'68, the insect was noted in several localities in England and Ireland, and was described by Westwood in 1867 under the name *Peritymbia vitisana.* In the meantime the Phylloxera had made its appearance in France, being introduced about 1859 on rooted American stocks. In 1863 the first signs of the evil were noted in southern France; in 1866 the work of this pest was clearly manifest in Vaucluse and Bordeaux, and later in Germany and Austria, where American vines had also been imported. The cause of the new and alarming disease of the vine had not yet, however, been recognized, but it was generally supposed to be of a fungus nature.

M. J. E. Planchon, in 1868, discovered the cause of the injury in a

root-louse, which he named *Rhizaphis vastatrix,* but was soon afterward able to refer it to its proper genus *Phylloxera,* by discovering winged specimens.

The leaf-gall forms were soon thereafter found in France, and correspondence between Jules Lichtenstein, of Montpellier, and Prof. Riley in 1868 and 1869 led them to surmise the identity of the gall and root forms and of the French and American insects. Westwood also expressed his belief in the identity of the American and French insects with the species described by him in 1867. Although these relationships had thus been surmised by different persons, they had not been proved, but investigations made by Prof. Riley, in 1870, fully established the correctness of these hypotheses, and being in France in the year following he was able to confirm his former conclusions and establish the matter beyond question.

From 1870 on, the spread of the Phylloxera was very rapid in all the vine countries of Europe, except Greece, where it has not yet appeared. In Switzerland its progress has been slow, and in Germany and Russia its advance has been effectively checked by means of the measures taken for its suppression.

Outside of Europe, as is well known, the Phylloxera has penetrated the remotest quarters of the globe. Australia was invaded in 1875, and in the United States, California, long free from this pest, has been infested now for several years, and the methods of reconstruction by the use of resistant stocks will have to be employed there if European grapes are to be grown in the future.

The loss occasioned to France alone by the Phylloxera on the basis of the report of the Superior Commission of 1884 was estimated by M. Lalande in 1888 as amounting to 1,200,000 hectares of vines destroyed, which at a valuation per hectare of 6,000 francs would give the enormous sum of 7,200,000,000 francs. If to this be added the cost of the raisins and wine imported to supply the place of the failure of the French vineyards, a sum amounting between 1875 and 1887 to more than 3,000,000,000 francs, we have a startling total of more than 10,000,000,000 francs or $2,000,000,000.

Life history.—The life history of the Phylloxera is briefly as follows:

It appears normally under four forms, which succeed each other regularly, with a variable number of generations each, and with a diminution in fecundity from the earliest to the latest forms.

These forms are the leaf-gall or multiplying form (*gallicola*), the root or destructive form (*radicicola*), the winged or colonizing form, and the sexual or regenerating form.

In the leaf-gall form the number of eggs deposited by an individual in the earlier generations is from five hundred to six hundred; the root forms deposit from one to one hundred eggs; the winged form from one to eight; and the last or sexual form but one

egg, which is the starting point of the cycle and has received the name of winter egg (*œuf d'hiver*).

The remarkable diminution in fecundity noted above, which has been noted also in the different generations of each form, as well as in the forms themselves, has given rise to a theory that if it were not for the regeneration and new vigor arising from the fecundated egg of the sexual form the Phylloxera would soon become extinct. This is the theory of M. Balbiani, the discoverer of the winter egg, and upon it is based a method of controlling the Phylloxera by the destruction of the winter-eggs. The theory is, however, not generally accepted, and M. Boiteau has recently recorded the rearing of successive generations of the root form for six years without any noticeable decrease in fertility.

The winter-egg is usually deposited on wood of two years' growth, sometimes on wood three years old, and rarely on still older wood. It is attached by means of a short stalk. In March or April, depending on the climate, the young louse is disclosed and at once proceeds to a freshly expanded leaf, in the upper surface of which it plants its beak. In a short time a depression forms about the young louse, which finally develops into the gall appearing on the opposite face of the leaf.

Full growth is reached in about fifteen days, during which three molts occur, and in two or three weeks from four hundred to five hundred eggs have been laid. These eggs hatch in about eight days and the young escape and migrate to all parts of the vine, attacking the newly expanded leaves. Successive generations of agamous females follow one another up to October, seven generations having been noted. There is a slight decrease in fecundity with each generation, individuals of the later group not depositing more than two hundred eggs.

With the coming of cold weather and on the death of the leaves the older or fecund individuals perish and the young pass to the roots, where they remain without sucking till spring, when they begin to attack the young roots and soon become what is known as the root form, or *radicicola*. The root form differs but slightly from the gall form, the galls and swellings on the roots being analogous to those on the leaves. It is this form only that causes the destruction of the vine. After three molts full growth is reached and egg-laying begins, the number deposited by a single agamous female not much exceeding one hundred. Five or six generations of these parthenogenetic egg-bearing apterous females follow each other.

During the summer and fall the root forms give rise to the winged females, which escape from the soil during the warm part of the day and flying to greater or less distances alight on other vines. The insect chooses the young, tender leaves, and going to the under surface

implants its beak and for twenty-four hours feeds on the juices. The eggs are then deposited in groups of two to four, either between the nerves of the leaves or in cracks in the bark of the vine, and are of two sizes—the smaller yielding males and the larger the females of the sexual generation. It has been frequently observed that eggs of both sizes are deposited by the same individual. It has been apparently equally well established, however, that certain of the smaller individuals lay only the male eggs.

Balbiani found that about two eggs in ten produced males; Mayet, in the course of investigations conducted in 1888, found that three eggs in ten produced males. The winged mothers die soon after oviposition and may frequently be found attached to the leaf near their eggs. These eggs hatch in nine or ten days, giving the last or sexual form, from which a new cycle begins. The insect in the last stage is very minute, resembling the newly hatched larval louse, and does not take any food, the mouth parts of both sexes being rudimentary. Almost immediately after hatching the union of the sexes occurs, one male serving for several females.

After fertilization the single egg in the female abdomen rapidly increases in size so that it fills the entire body of the insect, and is generally delivered the third or fourth day. After union with the male the female quits the leaf or young shoot where she was born and goes to the older parts of the vine and deposits the egg attached by a short stalk under loose bark or in cracks in the bark. The egg hibernates in this position until the following spring, when it gives birth to the wingless gall form again.

The two-year life cycle outlined above has been fully established by long and painstaking investigation by Prof. Riley in this country and in France by Planchon, Lichtenstein, Balbiani and others, and represents an amount of labor difficult of conception.

The course outlined is not, however, necessary to the continued existence of the species. Balbiani has found that the root forms may produce wingless lice, which again produce the sexual form similar to those coming from the winged females.

Regeneration may thus be effected underground indefinitely without the intervention of the winged form.

It has also been abundantly shown that the root form may continue the production of successive generations for a considerable number of years or probably indefinitely.

Prof. Riley has proved, further, by experiment, and the same has been done by others, that the young of the gall form of any generation may be easily colonized on the roots, where they give rise to the genuine *radicicola;* and it thus appears that it is possible—and it is doubtless the fact—for the gall lice to pass to the roots at any time during the summer. The reverse of this process, viz, the passage of the root lice directly to the leaves, is maintained by certain investigators, but seems to lack positive proof.

The complete cycle ordinarily requires two years or more, but, as will be seen from what has been given above, this period may be greatly reduced. Balbiani and others have found in fact that all the changes may be passed through in one year. The winged form has been obtained in August from roots where the gall form had been colonized two months previously.

The continuous reproduction of the root form is well shown in the case of the European vine of the *vinifera* class, on the leaves of which the galls rarely occur, although it was on a vine of this class, the *Tinto*, that the galls were first observed in France by Planchon in 1869. The gall form occurs abundantly on American vines, especially the wild varieties of *V. riparia* and the cultivated sorts derived from that species—Clinton, Solonis, Taylor, etc.

The leaves of the *vinifera* sorts are less favorable to the production of galls, and the galls are few in number, more or less rudimentary, and contain fewer eggs than with American vines. The passage of the lice from the leaves to the roots also occurs much earlier, commonly with the third or even second generation. The extreme susceptibility of the European vines to the root form is only too well evidenced in the history of viticulture during the last twenty years.

Means of Dispersion.—Interesting in this connection are the means of dispersion of the Phylloxera, which may be briefly stated as follows: (1) by means of the winged females, as already described ; (2) by the *radicicola* form : the young of the root form have been frequently observed to escape from cracks in the soil about infested plants and proceed actively to neighboring ones, these migrations being doubtless occasioned by lack of nourishment, and commonly occurring the latter part of August; (3) the young of the gall form are frequently carried by the wind or other agents, such as birds and insects to distant plants; (4) dispersion by man's agency, by the introduction of infested rooted plants which may bear either the root lice or the winter eggs on the stalk; and by the winter-eggs carried about on cuttings.

This brief outline of the life history of this pest will be useful in the following consideration of remedies. For a detailed account of this insect the reader is referred to Prof. Riley's fourth, sixth, seventh, and eighth Missouri reports and subsequent writings, or to the later French memoirs on the subject.

METHODS OF CONTROLLING THE PHYLLOXERA.

A few measures have been devised against this insect, which, under proper conditions, give fairly satisfactory results. These consist in (1) methods which avoid the necessity of direct treatment, viz, the use of American stocks and planting in sand; (2) the employment of insecticides—bisulphide of carbon, sulpho-carbonate of potassium,* and (3) submersion.

*See *Insect Life*, vol. III, pp. 188–9, for satisfactory results in California with kerosene and resin washes.

The employment of those American vines which resist the insect, whether direct or as stocks on which to graft the susceptible *vinifera* sorts, as recommended in 1871 by Prof. Riley, has been treated at length by him in a foregoing portion of this report (Chapter v); the planting in sand as a means against the Phylloxera may be, therefore, first discussed.

Planting in Sand.—The resistance of vines planted in sand attracted the attention of viticulturists at the very beginning of the Phylloxera invasion in France, and was noted by Prof. Riley in his earlier writings on the subject. The cause of the immunity of sandy soils is still somewhat in dispute. It is supposed to be in part the mechanical action of the particles of sand, preventing the formation of cracks and fissures through which the insects escape and migrate to adjacent plants. The sand also by its more perfect capillarity becomes thoroughly soaked with rain or subterranean moisture and the insects are thus drowned out, as in artificial submersion. The resistance is proportionate to the percentage of sand in the soil. Vines resist perfectly in soils of pure sand, and in proportion to the increase of clay the power of resistance diminishes. An insecticide effect is also claimed for the sand, which however has not been satisfactorily explained. The resistance of the sand increases with the proportion of silica, sands largely calcareous being less resistant. If a considerable amount of salt (chloride of sodium) occurs in the sand, vines can not be grown successfully, but the salt may frequently be washed out by irrigation and submergence sufficiently to allow the growth of the vine.

In France and Algeria on the authority of Foëx vines may be profitably grown in all sands not low and salty where the silica exceeds 60 per cent. Vines will do well, he says, in the sandy dunes of Gascogne, of those bordering the Gulf of Lyons, in sands along the seashore of Tunis and Algeria. They also flourish in the alluvial sands in the valley of the Rhone and other streams.

Planting in sand has proved extremely successful, though very much limited in area. In this method nothing is changed from the old methods of viticulture except that the vine is planted in a soil where the Phylloxera can not thrive, and where an underlying supply of water greatly aids the cultivation. Some very successful plantations have been made among the hitherto waste sands of Aigues-Mortes, and it has been recommended to increase the area by leveling the dunes along the borders of the Mediterranean or perhaps in the Landes.

Bisulphide of Carbon.—The use of this well known and powerful insecticide against the Phylloxera was first made by Baron Thénard in 1869 in the neighborhood of Bordeaux. His first experiments were not successful, owing to the difficulty experienced in forcing the chemical to a sufficient depth, and the vines were killed by

over-dosing. Later experiments at Montpellier (1873) by M. Monestier were quite successful and the use of this insecticide rapidly increased. The latest report of the Superior Phylloxera Commission places the number of acres treated with this substance at 145,000. The nature of the soil is of great importance in the use of bisulphide of carbon; in compact clay soils the vapor will not penetrate satisfactorily and in light sandy and stony soils the vapor escapes too easily. Medium soils may therefore be most profitably treated with this substance. In the presence of excessive moisture, the sulphide evaporates slowly and remaining in the liquid state it is liable to injure the roots of the vine. In very dry soils also, especially if they are cracking, the easy escape of the vapor renders treatment of little avail.

In general the bisulphide of carbon should be applied at the first sign of the presence of the Phylloxera, and may be successfully used at any season of the year. Following treatment, there is, in the growing period, always a slight checking in the growth of the roots and leaves, and if made at the time of blooming or just before the ripening of the fruit (*véraison*) this may result disastrously to the crop. Applications at the periods named are therefore generally avoided.

The treatment consists in introducing into the soil about the vines a certain quantity of the bisulphide, either by means of injectors or plows or by diluting the bisulphide in water and thoroughly wetting the soil about the vines with the resulting mixture. The great volatility of the bisulphide enables it to reach the minutest roots, and the lice quickly succumb.

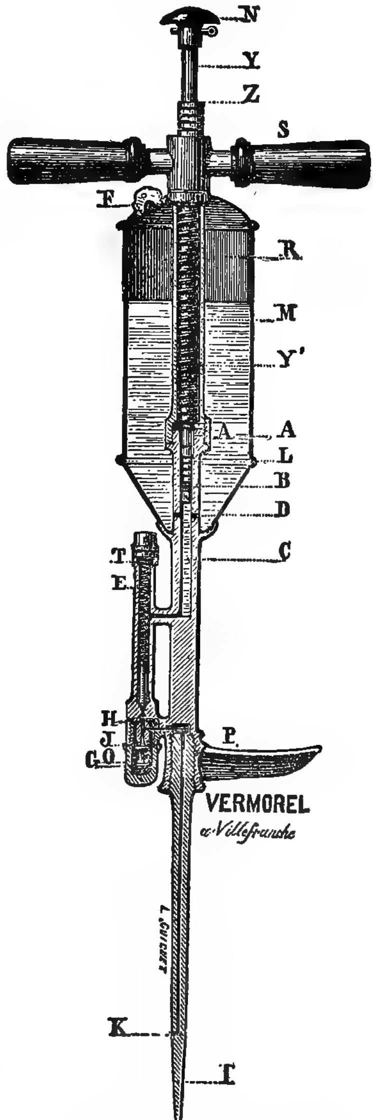


FIG. 193.—Vertical section of the Vermorel pal-injector. (From Sahut.)

The best apparatus for the purpose is the pal-injector invented by

Gastine and perfected by V. Vermorel (Fig. 193). It consists in general of a cylindrical reservoir terminated by an injecting tube. A hydraulic pump within the reservoir, the piston of which pro-

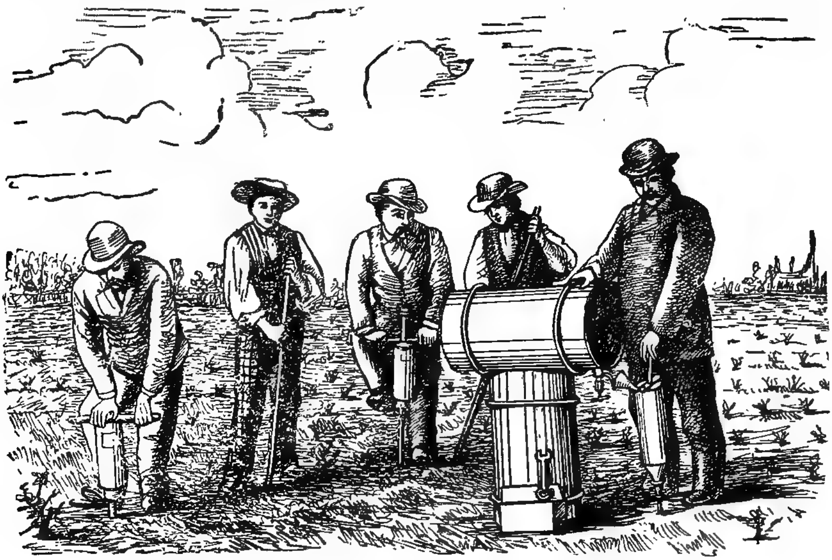


FIG. 194.—Treatment of the vine with the pal-injector. (After Barral.)

jects above the two handles S, serves to inject into the soil through the perforation K at the bottom of the tube the desired amount of liquid. In operating the instrument, force the tube into soil by means of the foot-rest P, press strongly on the handle of the piston N, remove the tube and close immediately and firmly the hole left by the tube. The instrument should be inserted vertically and to a depth of 0.30 to 0.40 meter, except near the vine, where the depth should be from 0.08 to 0.10 meter and the approach to the base of the vine should not exceed 0.25 meter. (See Fig. 194.)

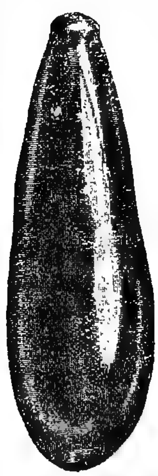


FIG. 195.—The Jamain capsule.

The number of injections to the square meter will vary, a large number of small doses being always preferable to a few large ones. The general practice is to make from two to three injections to the square meter in light or medium soils and four in heavy clay soils.

A new method of introducing the bisulphide was shown at the Exposition by M. Jamain, of Dijon, and seems to be of sufficient merit to warrant notice. The bisulphide, either alone or mixed with creosote or petroleum to render it less volatile, is inclosed in gelatine capsules holding from 2½ to 10 grams. These are buried in the earth about the base of the

vines and are slowly disintegrated by the moisture of the ground and the insecticide is liberated. (See Figs. 195–197.)

The plow or traction injectors are devised to introduce into a continuous cut or opening in the soil a certain amount of the liquid, and are especially adapted for extensive applications in vineyards regularly planted in rows. Machines of this class are of more recent invention than the hand injectors, and by reason of their rapid and economical work have already gained an extensive popularity.

The machines in general use are those of MM. Gastine, Vernette Saturnin, Cabal, Vermorel, and others. The traction injector of M. Vernette, of Béziers, is commonly employed in the Languedoc district and may be described and figured as a type of this class of machines (Fig. 198).

It is formed essentially of a plowshare to open the soil; of a reservoir for the liquid E; of a discharging apparatus B, which allows the passage of the bisulphide at a definite rate through the tube F′ to the bottom of the furrow; of a wheel R which closes the furrow and moves the distributor B; and, finally, of two handles, of which one A′ serves to direct the apparatus while working and the other to raise it in turning, etc. With these traction injectors the lines of injection are commonly separated about 1 meter; in the case of vines planted in rows separated by 1 meter, or but little more, one passage of the injector between them is considered sufficient; where the distance between the rows is from 1½ to 2 meters, two lines of injection are made. The amount of bisulphide employed per acre ranges from 150 to 240 kilos.

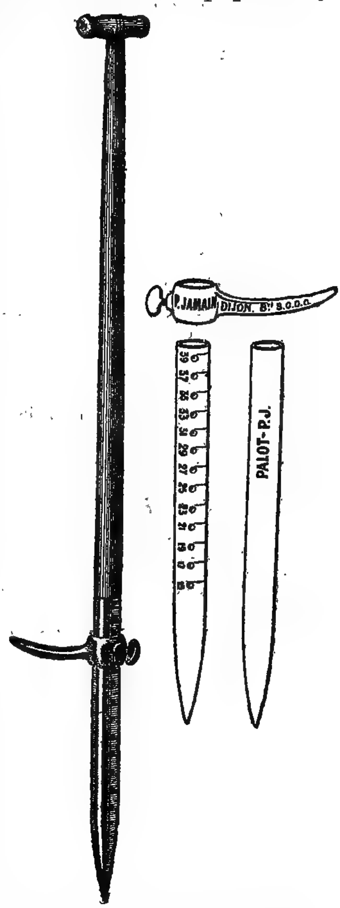


FIG. 196.—Graduated instrument employed in placing the capsule.

The use of the bisulphide not only to control the Phylloxera but to entirely exterminate it by destroying the infested vines and lice at the same time, known as the *traitement d'extinction*, was first made in Switzerland, and more recently in Germany, Russia, and Algeria. In Switzerland 300 grams of the bisulphide were applied to each vine in two doses of 150 grams each at an interval of twelve days. The vines are killed ninety-nine times out of one hundred. No vines are again planted for five years. The ex-

pense of the application and the resulting loss to the vineyardist is in part met by the Government. The success of this radical treat-

FIG. 197.—Method of inserting the Jamain capsule.

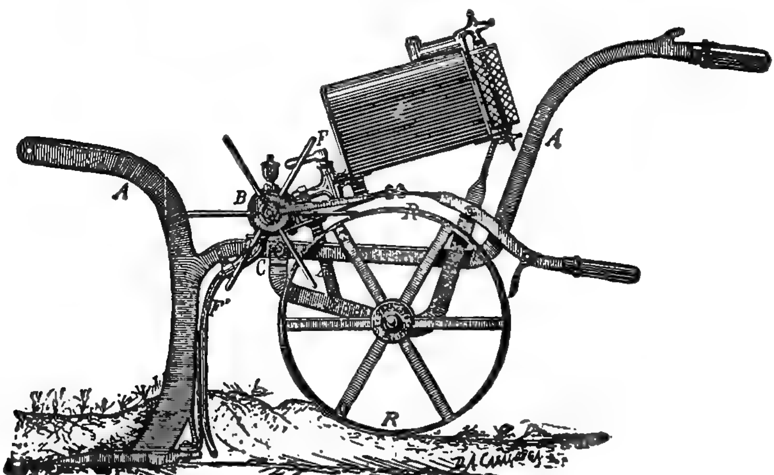


FIG. 198.—Perfected sulphuring plow of Vernette. (From Sahut.)

ment is seen in the comparative freedom of the countries named from the Phylloxera.

The results with the bisulphide of carbon have been especially satisfactory in north France where the Phylloxera multiplies slowly, and where it was used at the very outset of the invasion. In south France, the region known as the Midi, where the vine is frequently destroyed the second year after the first appearance of the insect less success has attended its use.

The use of the bisulphide dissolved or diluted in water was suggested by the fatal results to the vines occasionally following the employment of the pure liquid. It was first proposed by M. Cauvey in 1875 and again in 1882 by M. Rommier, but only within the last four or five years has its use been rendered practicable by the in-

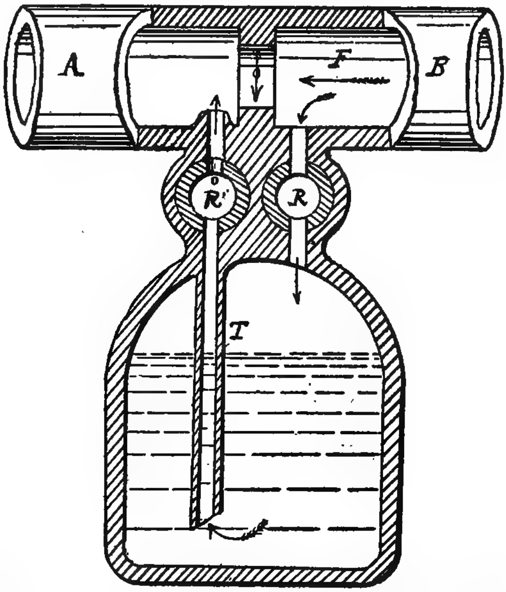


FIG. 199.—Section of the Fafeur apparatus. (Copied from Mayet.)

vention of an apparatus for combining the water and the heavier bisulphide devised by the Fafeur frères.

This apparatus is shown in section at Fig. 199, and consists of a reservoir for the bisulphide attached to the pipe AB, through which the water is forced by means of a hand-power or steam pump. The reservoir is connected with two openings provided with stop-cocks R and R'. The tube AB is contracted at o, and the water being forced through it is by the contraction forced down through the tube R. The bisulphide, which is always at the bottom of the reservoir, is forced out through the tube T to mix with the water passing through the pipe AB. The amount of bisulphide discharged can be regulated by means of the stop-cocks.

The treatment consists in opening a small basin about the base of each vine and pouring in each basin a quantity of the mixture amounting to from 15 to 18 liters per square meter of surface, the mixture containing from 0.4 gram to 0.6 gram of bisulphide per liter for summer treatment, and for winter treatment 0.6 gram to 0.8 gram per liter. The method of making the application is shown in the annexed figure (Fig. 200). The large quantity of water required for this treatment restricts its use to the vicinity of streams or abundant water supplies.

Sulpho-carbonate of Potassium.—This substance has to recommend it the fact that it is at once a fertilizer as well as an insecticide of considerable value. M. Dumas, in 1874, observed that, submitted to the action of the carbonic-acid gas of the air and moisture, the

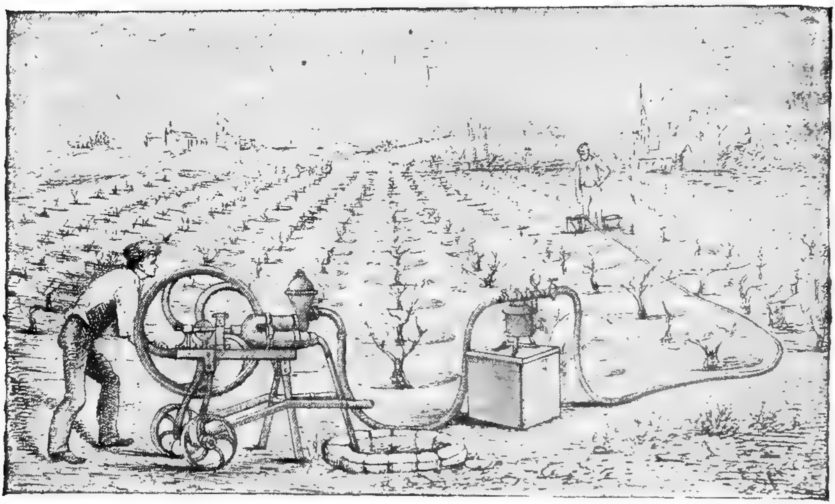


FIG. 200.—Method of using the Fafeur apparatus with hand pump. (From Mayet.)

sulpho-carbonate of potassium and sodium decomposed slowly into carbonates valuable as fertilizers and bisulphide of carbon, the value of which as an insecticide was already established. Experiments were immediately conducted by M. Cornu, at Cognac, with these substances, and remarkably satisfactory results were obtained both as regards the action of the fertilizer and the insecticide. It was then thought that these substances, or rather the sulpho-carbonate of potassium, which proved the superior, would take the place of the bisulphide of carbon. This has not, however, been the case, as the following figures show: In 1886, the number of hectares treated with bisulphide was 47,215; with the sulpho-carbonate, 4,459; in 1887, with the bisulphide, 66,205; sulpho-carbonate, 8,820. The last report (1889) of the Superior Phylloxera Commission gives 145,000 English acres as treated with the first and but 23,000 with the last.

The sulpho-carbonate is employed in the liquid state, and is diluted in a quantity of water sufficient to saturate the soil containing the roots of the vine. The great quantity of water thus rendered necessary is the chief objection to the treatment and has doubtless prevented its more extended employment. The application is made in winter, after the vines have been pruned, at which period it is easy to get to the vines, and, also, there is little danger of injury from the bisulphide. At this season, also, less water is required by reason of the more frequent rains. A second application is, however, recommended in July in the caseof vines severely attacked. The preparation for this treatment consists in raising about the base of the vine little embankments of earth, forming a rectangular basin. These

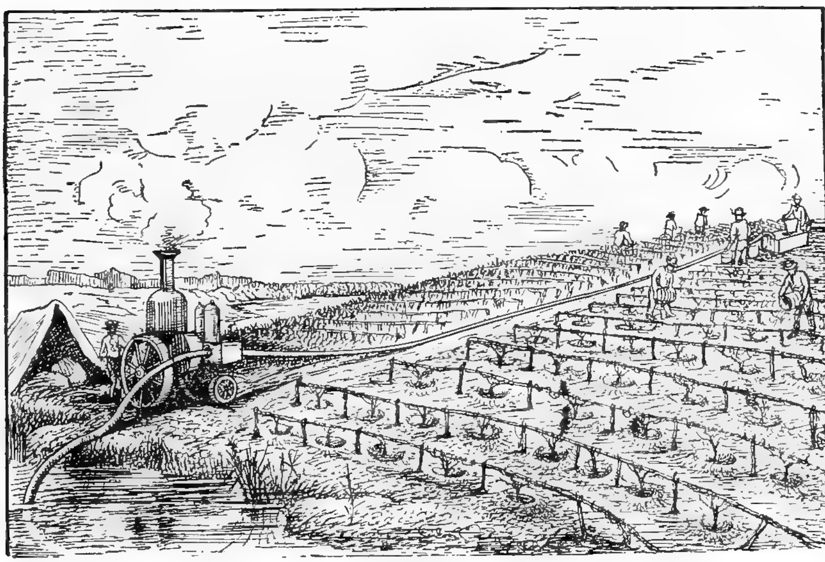


FIG. 201.—The sulpho-carbonate of potassium treatment of the vine. (After Barral).

basins may include one or several stocks, and the embankments are made commonly by hand, but also with the aid of a plow. After waiting a few days for the earth to become settled, the sulpho-carbonate is poured in each basin at the rate of 40 to 50 grams per square meter, mixed with 10 to 15 liters of water, depending on the permeability of the soil. This amounts per hectare to a total of 400 to 500 kilos of the sulpho-carbonate and 100 to 150 cubic meters of water.

For the transportation of the water MM. Muillefert and Hembert have devised an extensive apparatus, consisting of an engine connected with a force pump, from which the water from the stream or well is conveyed by pipes to a reservoir in the vineyard and from there to smaller receivers or sub-reservoirs, where the sulpho-carbonate is mixed with the water by hand. From these the mixture is

carried to the vines in vessels and if the arrangement of sub-reservoirs is complete the water need not be carried by hand more than to a distance of 10 meters. (See Fig. 201.)

Destruction of the Winter-egg.—Reference has already been made to the theory of M. Balbiani, relating to the gradual diminution in the fecundity of the successive generations of the Phylloxera and the importance of the winter-egg to the regeneration and continuance of the species, and also to the method of controlling the Phylloxera by destroying this winter-egg. The treatment consists in painting or washing the vines during the winter with some substance or mixture that will destroy the egg. After various experiments M. Balbiani contrived a mixture which answered the desired end very well. It is made as follows:

	Kilos.
Heavy coal-tar oil	20
Crude napthaline	60
Quicklime	120
Water	400

The napthaline is first dissolved in the oil; the lime is slightly slaked in a cask and on the hot lime is poured the mixture of oil and napthaline, the water is then added, and the whole stirred until well mixed. The vines, preferably decorticated, are thoroughly coated or painted with the mixture. This treatment is successful in so far as the destruction of the eggs is concerned, but, as already indicated, it is not effective in exterminating the Phylloxera. The ability of the root form to reproduce itself indefinitely, together with the probability that the fertilized egg is also produced by the root forms, sufficiently accounts for the failure of this method. It may, however, be recommended in connection with the other remedies.

Submersion.—The practice of submerging vineyards did not originate with the phylloxera invasions. It seems to have been the custom from time immemorial in south Russia and in Greece to inundate vineyards during winter to rid them of hibernating snails and insects. Its first application against the Phylloxera was made by Dr. Seigle, of Nismes, in July, 1868. Taking advantage of a canal leading from the river Durance and surrounding his property, Dr. Seigle inundated his vineyard for twelve consecutive days in July, eight days in October of the same year, and in the year following three additional inundations were made. These five inundations effectively destroyed the Phylloxera and left his vineyard in as good condition as it was previous to the appearance of this pest.

The practical outcome of this and subsequent experiments led to the general adoption of submersion wherever it was possible to practice it. At present submersion is practiced upon 27,000 hectares of French vineyards; but when the canals projected or in course of construction are completed it will be capable of much

greater extension. The Rhône Canal alone, according to M. Dumont, the author of the project, will permit the inundation in winter of 80,000 hectares of vines. It is found that submerged vines give the best harvests, their production varying from 100 to 200 hectoliters per hectare, while 250 hectoliters is not rare. Unfortunately submergible regions are of limited extent and the method itself is not yet fully understood and has even been the object of unjust prejudices, although there are less obstacles in its way than in that of any other treatment.

In general it can be said that inundation is the only infallible method of destroying the Phylloxera and should always be practiced where feasible, unless use is made of resistant stocks, or in vineyards planted in the sands. All soils are not equally suited to submersion. It is necessary that they be neither too compact nor too loose. The best results are obtained when the soil is such as to

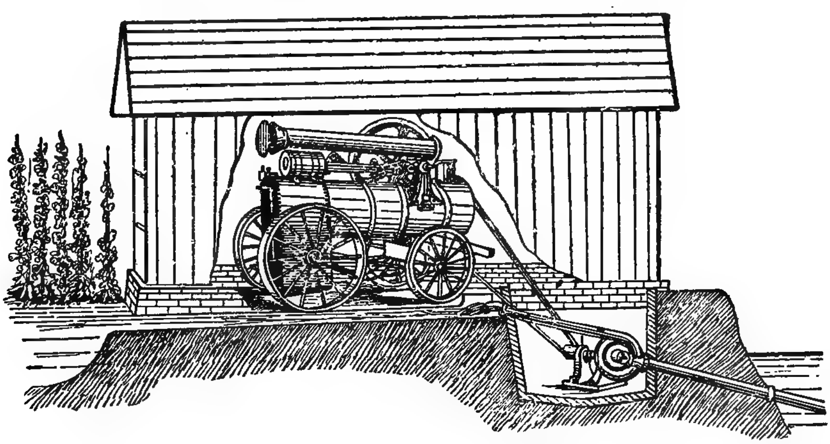


FIG. 202.—Gwynne centrifugal pump, connected with mounted engine. (From Mayet.)

allow penetration by the water in twenty-four hours of from 1 to 5 centimeters. If the water reaches a depth in this time of 8 to 10 centimeters the quantity of water required is so great as to render its application impracticable.

Submersion is limited practically to the vineyards of south France included in the olive region and planted on level land and in the vicinity of water courses or artificial and natural water reservoirs. Where vines are grown on hilly land it is of course impracticable, and in north France the colder winters make inundation dangerous to the vines. Up to the present time it is practiced chiefly in southeast France and in the southwest beyond the Gironde and in the neighboring departments. The amount of water required per hectare ranges according to the soil from 10,000 to 30,000 cubic meters. The duration of the submergence to be effective also varies with the soil and with the climate.

In the northern regions (Drome) the submergence may be limited to twenty-five to thirty days, while in the more southern regions, where the phylloxera multiplies much more rapidly, thirty to forty days will be required.

The treatment may be made at any season of the year, but it has in practice been found advisable to make it during the winter. In summer, while the lice are in full development and active, their destruction is easier than in the dormant, resting condition of the winter season, but the liability of checking the growth of the vine by a summer application renders it inadvisable. The different varieties of grapes do not all behave alike under submersion. Those subject to cryptogamic diseases are rendered more liable to attack,

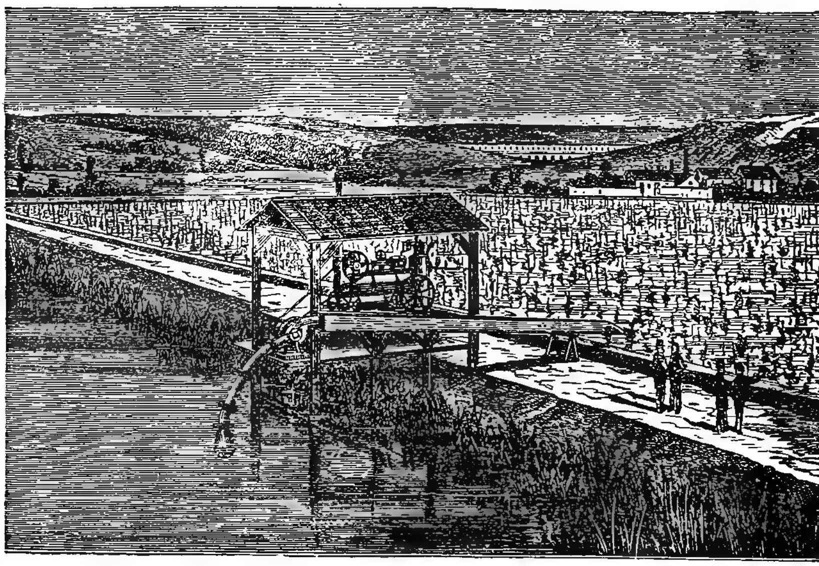


FIG. 203.—Inundating vineyard with centrifugal steam pump

and such varieties may be better protected by grafting on American stocks.

In submerging, as practiced in France, the vineyards are commonly laid off in squares or rectangular plats, the latter for sloping ground. Around these plats walls of earth are raised, varying in dimensions with the size of the plat, and these walls are protected from erosion by planting them with forage plants, the common *Trifolium repens* being recommended for this purpose by Foëx. During the first year the exposed side of the embankment is commonly protected with roots, cuttings, or reed grass.

Where possible the water is introduced most satisfactorily and cheaply from canals, as in irrigation; otherwise various elevating machines are employed. The greater part of the submersions are

made by means of centrifugal steam pumps, which are either stationary or arranged to be transported from place to place. The pumps generally employed are those of L. Dumont and of J. & H. Gwynne, those of the latter being combined with a mounted engine for transportation. A mounted engine and Gwynne pump is represented at Fig. 202. The illustration on the preceding page (Fig. 203) represents the submerging of a vineyard in a river valley by means of an apparatus similar to the one figured above. It is sometimes possible to substitute water power for steam in the elevation of water, which, of course, greatly lessens the cost of the application.

CHAPTER VIII.

EXHIBITIONS OF LIVE STOCK.

By C. V. RILEY and AMORY AUSTIN.

Two exhibitions of live stock, one of cattle, sheep, swine, poultry, and rabbits, the other of horses and asses, were held during the summer, in connection with the Exposition. These were located in temporary sheds under the trees upon the Cours-la-Reine, between the Palais de l'Industrie and the river. A show of dogs, not connected with the Exposition, was held in the garden of the Tuilleries. The cattle and poultry show was held from the 13th to the 22d of July. There were some 1,500 head of cattle, 800 sheep, and 300 swine, classified in two categories; first, those of foreign races, born and raised abroad; and, secondly, those of French or foreign races born and raised in France. Of these, 383 head of cattle, 138 sheep, and 68 swine were shown by foreigners, 208 of whom were from Great Britain and Ireland, and 182 from Belgium. There were also exhibitions from Switzerland, Holland, Italy, and Denmark, but none from the United States, probably on account of the difficulty and risk of sending valuable animals across the ocean.

Shorthorns.—The improved Durham race continues, as in 1878, to be one of the most appreciated in France, and even further improvement has been made in it. The English exhibit of Shorthorns, although not equal to that of 1878, and less numerous than that made by France, came off best in prizes, winning seven out of fifteen, the French taking five prizes and the Belgians three. The prize bull of the cattle show was, however, not a Durham, but a French bull of the Limousin breed, raised in the department of Haute-Vienne. Many more English entries of Shorthorns would have been made had it not been for a law intended for protection against the foot and mouth disease which prohibits the entry into that country of cattle coming from the Continent, so that cattle sent from England for exhibition in Paris were not permitted to return. Many English Shorthorns, however, had been sold to South American buyers, and it is said that some of these were exhibited at Paris on their way to Buenos Ayres. The French Short-

horn differs somewhat from the English type; about 150 of these were exhibited and were much admired. Several crosses of the Durham breed were shown, and consisted of cows only, the bulls, as is well known, not improving by cross-breeding; the Durham-Manceau or cross with the Mayenne breed was the best of these, and there were also Durham-Normans and Durham-Flemish. Many of the French-bred Durhams were sold at the Exposition, and were even preferred to the English by South American buyers. Bulls were sold averaging 15 to 26 months in age, and a good bull brought as much as 6,000 francs, while the cows brought from 2,500 to 3,000 francs each.

Herefords.—These were few in number, but of remarkably good quality. This race grows rapidly when well fed, and the oxen are good workers and fatten more easily than those of the Devon or

FIG. 204.—French-bred Durham bull. (From Journal de l'Agriculture.)

Sussex races, and for beef are equal if not superior to the Durham oxen. The cows are good milkers but as a rule do not give so much milk as the Norman cows. Being almost as precocious as the Durhams they are much appreciated by the Australians and South Americans.

Of other English races there was a good general exhibit, especially of Jerseys, some of the best of which came from the Ferme d'Arcy-en-Brie, of which an account will be found elsewhere. The Suffolk and Angus polled cattle that were shown did not equal the display made in 1878. There were a very few Highlands and no Devon or Sussex, though there was a fine show of Kerrys and Dexter-Kerrys. These small black Irish cows rarely weigh more than from 650 to 750 pounds and in form and build seem to be a combination of the Jer-

sey, Brittany, and Ayreshire races. They are small consumers of food, and graze well upon rough land; they are also very hardy and will stand very severe winter weather; they are very docile and as milkers they yield an abundant supply of excellent quality. It is said that some of them average 16 quarts daily. Altogether these breeds are coming into notice, and are worthy of more serious attention from American stock-breeders. Unfortunately very little care has been taken in Ireland to keep the breed pure. The Kerry proper is not much more of a beef animal than the Jersey, but the Dexter-Kerry makes good beef, fattening quickly and weighing from 400 to 500 pounds when dressed.

Belgium and Holland were well represented. Both countries sent many cattle of the Hollandaise race, those from Belgium mostly

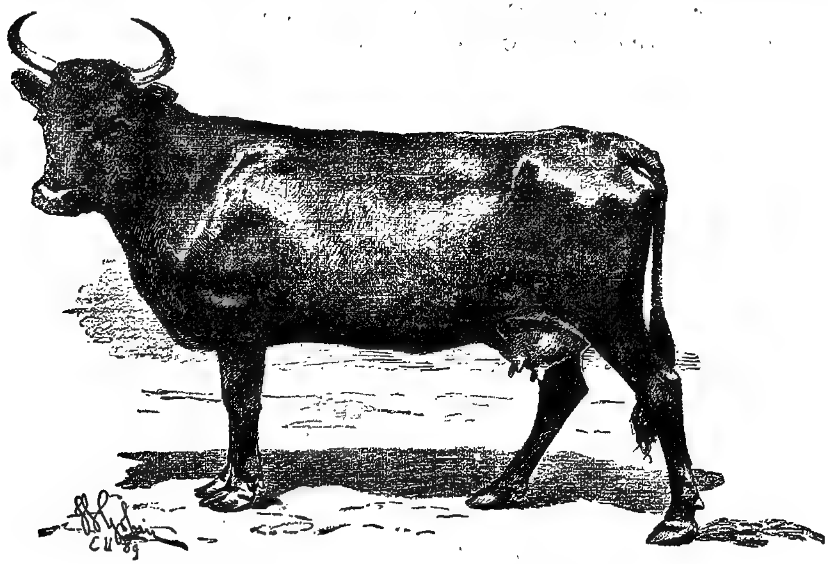


FIG. 205.—Kerry cow. (From Journal de l'Agriculture.)

coming from the neighborhood of Mechlin, which is a market for milch cows, while those from Holland were sent under the auspices of the Dutch Herd Book Society. Many cows of English origin were shown by the Belgians. The so-called Polder cattle did not differ notably from the Hollandaise; the latter are common in northern and northeastern France and are very popular.

The *Angeln race* is the most common in Denmark, and also in the duchy of Holstein, and several good specimens were sent from that country to the Exposition. This race is a strain of the *Holstein*, or *Hollandaise*, as the French call it. Many are bought by Americans, and the race is in fact scattered over the world, being found in South America, Australia, New Zealand, and even in the Sandwich Islands, where there are large herds of it. The *Angelns*

differ but slightly from the Hollandaise, being a little smaller, but having the same general characters. Their form is fine and regular, and some of the cows give as much as 3,000 liters of milk yearly or even more. Their milk is richer in butter than that of the Hollandaise. Immense progress has been made in cattle-raising and in dairy matters of late years in Denmark, and this is one of the results.

Switzerland made a notable exhibit at the cattle show. In France there is a tendency to multiply the number of races and breeds of cattle; in Switzerland the tendency is in the opposite direction, so that there are, properly speaking, only two Swiss races, the spotted and the brown. The first of these, spotted black and white, is the *Freiburg race*, and has a tendency to run to great size; owing to a misunderstanding among intending exhibitors, very few Freiburgs found their way to the Exposition. An important breed of this race is the *Simmenthal*, also called the *Bernese*, in which the black

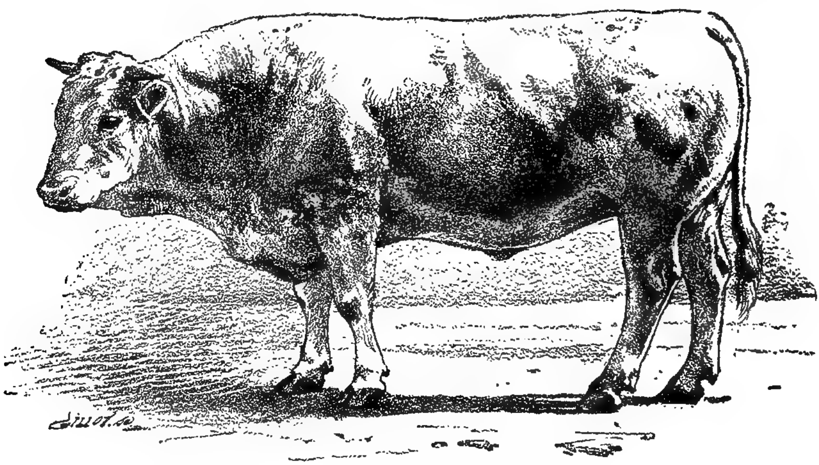


FIG. 206.—Simmenthal bull. (From Journal de l'Agriculture.)

color is replaced by a reddish brown, more or less inclining to yellow. The race is extensively raised in the canton of Berne, especially in the valley of the Simmen, where great care has been taken in selection, so that in twenty years the race has been greatly ameliorated. Animals from this valley are of somewhat lighter color than those from the rest of the canton, hence an erroneous distinction into two different races has arisen, the two in reality forming but one. Any black spots seen upon the horns or muzzle are regarded by breeders as signs of impurity in this race. These cattle are gentle in disposition and are very hardy; they have a very regular form and light, well-poised heads, large foreheads, and bright eyes and rose-colored or brown muzzles; the horns are rather short, and are white, being often tipped with brown, and project in front, not being upturned; the dewlap is very large toward the breast, the chest is large and

the back broad and straight, and the limbs are strong; the tail, however, is attached rather too high up. When these cattle descend from mountain pastures their skin is somewhat thick, but becomes supple again after some time passed in the stable.

The race is essentially a milking one, and some good averages show 8 to 10 or even 11 liters per day. The oxen are good workers, and the beef is so good that it commands an advanced price at the Paris markets, which, however, it rarely reaches. A great trade in these cattle has sprung up, and at the fair at Erlenbach several thousands are annually sold, most of which go to the valley of the Rhine and other parts of Germany. The race is supposed to be of Scandinavian origin, and is entirely unlike any other race known in Switzerland. Hitherto experiments in crossing with Durham have been few in number, Swiss breeders rightly preferring to improve their stock by selection alone.

Many of the dark-brown *Switz*, the second of the Swiss races were shown, coming from St. Gallen, Zurich, and Grisons, those from the latter canton being somewhat smaller than the others. These cattle are much appreciated in southeastern France, and are tending to spread there, though the Simmenthals are comparatively unknown in France.

French Races of Cattle.—The remarks made by Commissioner Dysart about French races in 1878 * hold good to-day, as also do all his descriptions of the French and other breeds and races. The *Normandy* continues to be the most noted dairy breed, and many fine specimens were shown. Further improvement in this breed is looked forward to since the establishment of a special herd-book. These cattle, also called *Cotentin*, are good milkers, but demand abundant and appropriate nourishment (see the account of the Arcy Farm, Chapter x), and the fine pasture lands of Normandy seem to suit them well—witness the great reputation enjoyed by the butter made at Isigny (Calvados) upon the English Channel. Crossing with Shorthorns has produced cattle more precocious and of better conformation, and has increased their fattening qualities, but it is generally conceded that the milking qualities of such progeny are not equal to those of pure Cotentin mothers. However this may be it is certain that the pure Durham race generally gives less milk than the Norman.

Breton cattle were very numerous, and have been much improved since 1878 both as milkers and as beef cattle; great uniformity was perceptible among them.

There was a very small exhibit of *Cherolaise*, but a good one of the *Nivernaise-Cherolaise* breed, which, however, did not show that

*See Report upon Live Stock, by Samuel Dysart, United States Report upon Paris Exposition of 1878, Vol. v, p. 314.

wonderful uniformity of form and color usually seen among members of the same French breed. Much attention was attracted by the *Limousin* race, which furnished the prize bull of the show (which, by the way, was sold to go to South America). In addition the collection of these cattle was one of the finest ever made. It is claimed that the Limousin breed may be made, without any admixture of other blood, to acquire great precocity, and yet to keep all their other good qualities.

The *Garonnaise* cattle are very hardy and their beef is much in demand. Improvements might be made in them, however.

The *Flemish* race, of French raising, was well represented, although not so common now as formerly. The cows are especially appreciated for dairy purposes, and the prize cow of the show was of this race. Those exhibited were uniform in appearance and of a red or red-brown color.

The *Parthenaise* race of cattle, originating in the old province of Gatine, now the Department of Deux-Sèvres, is one whose good qualities have been hitherto much neglected, though well worthy of attention. The cows are as good milkers as any others, even the Norman cows, and instances are known, though they are rare, where Parthenaise cows have given 20 liters daily. With abundant feeding the milk is very rich in butter, especially when the cows are pastured upon the lias and oölitic soils of the Department. When the pasturing is done upon schistose or granite soils the milk is found to more abundant and richer in casein but poorer in fatty matters.

The oxen are strong and energetic workers, and when fattened they make good beef, but they have the great disadvantage of fattening slowly.

This race is rarely found in France outside of the Department of Deux-Sèvres, and is there tending to disappear, being driven out by the *Durham-Manceau* and *Salers* races. The Durham-Manceaus fatten more quickly than the Parthenaise oxen, which, in the eyes of the thrifty Gatinais farmer, is a serious consideration against the latter, although the former are not such good workers and their beef is not particularly fine, while their cows are not such good milkers. Besides, the Parthenais are not precocious, although this quality might be imparted to them by crossing with the Limousins. No care is taken, however; there is no selection and no good feeding. Bulls are put to service at the age of 15 months and cows at the age of 12 months, which is altogether too early; the calves, also, are weaned too soon, and no care is taken to supply better food to cows while in calf. Oxen are put to work at the age of 3 to 4 years and worked till 7 or 8. In short, the race is an excellent one, but neglected, and is susceptible of great improvement, its greatest needs

being careful selection, good nourishment, and a carefully conducted herdbook.

Algerian cattle were also exhibited. The *Guelma* or *Cheurfa* race originated in the Department of Constantine, and has spread all over Algeria and Tunis, the best specimens coming from the neighborhood of Guelma and Bona. These cattle measure from 1.20 to 1.40 metres (3.9 to 4.6 feet) in height, and weigh from 160 to 350 kilos (353 to 772 pounds). They are well built, with small heads and short necks, straight backs, short flanks, and finely shaped limbs; the skin is fine and thin, and the color is a mouse gray, with darker shadings upon the extremities and around the eyes and nostrils; the horns are well shaped, but not much developed, and are generally gray or white. The race is very hardy and does not suffer from variations of climate or from irregularity in feeding. The oxen are agile and strong, are good workers and are easily fattened, making good beef. The cows, however, are not good milkers, giving only 4 to 5 liters daily for about five months in the year, but they are easily fattened. Algeria contains about 1,227,000 head of cattle.

SHEEP.

The principal races upon exhibition were the Merinos, Southdowns, Leicesters or Dishley-Merinos, and Lincolns, coming both from England and from France. England made a much better show of sheep than she did of cattle, and some fine specimens, especially among the Southdowns, were shown. There were, however, very few Cotswolds, Cheviots, or black-faced sheep. The most noteworthy French sheep were the Merinos and the long-wooled races known as the Artesian, Norman, and Picard, together with mountain sheep, Charmois and Causses. From Belgium were sent Texels and Polders. Most of the Dishly-Merinos were too fat. A French breed worthy of mention is that of the *Causses du Quercy*, coming from the valley of that name in the Department of Lot, in southwestern France. This breed is of moderately long body, but has very long legs and comparatively thin bones; the sides are flat and the thighs bare of flesh; the head is strong and the rams are generally hornless, while the face has black spots, as has also the pendant. The breed, in fact, much resembles the Algerian. The fleece is long, of ordinary quality, glossy, and little charged with dirt, and the head and legs are bare of wool. This breed is very hardy, withstanding the severe winters of the Causses, and, though rather hard to fatten, makes good mutton. They are good walkers, and often make 20 or 25 kilometers a day in search of food among the poor pasturage of the Causses. The ewes are good milkers, and their milk, either alone or mixed with cows' milk, is much used in

Quercy for cheese-making. By judicious crossing and with bettre pasturage, as by the introduction of sainfoin, much improvement might be made in this breed.

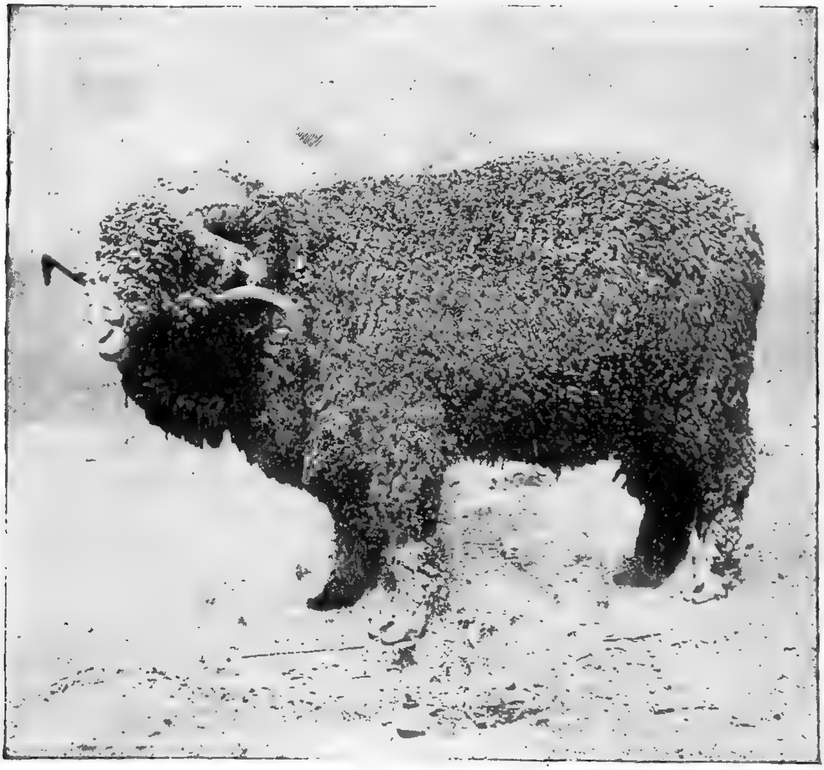


FIG. 207.—Merino ram.

SWINE.

There were about three hundred swine, divided into French and foreign breeds and again subdivided, the French into the Normandy and Craon breeds, with several smaller ones, and the foreign swine, mostly English or Belgian, into classes according to size. There were also several of mixed breeds. Some fine specimens were shown and the exhibit was, on the whole, a good one.

Much confusion exists regarding races and varieties of swine. According to M. Sanson, a French writer, there are only three races of pure type, and all others are varieties or mixtures of these. Two have been European from time immemorial, the Celtic and Iberian, and one is Asiatic, and all these have greatly differing characteristics.

The Celtic race has a broad forehead and long face and snout, the

forehead forming an obtuse angle with the root of the snout: the ears are large and pendant and almost conceal the eyes, the neck is long and thin, the body much elongated, the back is arched and narrow, and the legs are very long. The bristles are coarse and abundant and of a yellowish or reddish white, and the skin is pink and entirely free from pigment. This race runs to flesh rather than to fat. The sows are very prolific and have from twelve to sixteen or even eighteen or more young at a birth.

This race formerly inhabited Gaul and is now found in its purity only in the west and northwest of France, where its original home probably lay. Thence it has spread over the British Isles to the west and over Northern Europe to the east and northeast and as far south as central Italy, and probably to Greece. It is now probably the only race found in purity at agricultural shows, and many of the so-called races are only varieties of it, such as the French races of Normandy and Brittany and the Craon and Mancelle.

The Iberian race has a narrow forehead and short face and snout, the forehead forming a gentle curve with the root of the snout; the ears are long and narrow and are directed obliquely forward, and do not hang down, but are almost horizontal; the neck is short and moderately thick, the body is of moderate length, cylindrical, and with a straight back; the legs are rather short and very muscular; the bristles are sparsely distributed and are almost always black or red or gray, and the skin strongly charged with pigment. This race also runs to flesh rather than to fat, and the sows are less prolific than those of the Celtic race, rarely having over eight or ten at a birth. This race is formed of a uniform black color only in Italy, Sicily, Malta, and Greece or in the south of Spain, and probably originated in one of these countries, most probably in the latter. It is this race which was carried by the Spaniards to America, and, in fact, all over Europe wherever they have occupied territory, as in the Netherlands. It is also found in the south of France, in the Danubian States, and in Hungary, and, in fact, all over southern Europe. The black Neapolitan swine are of this race, being probably its best representatives.

The Asiatic race has, like the Celtic, a broad forehead, but has a short face and snout, which stands almost at a right angle to the forehead; the ears are short, small, and erect; the neck is short and very thick, and the body short and cylindrical, with very short, thin legs, and the whole animal is of small stature. The bristles are not abundant and are of varying color—white, black or reddish, and sometimes of variegated color; the skin is generally charged with pigment in pure individuals, but not always so. This race runs to fat rather than to flesh, and is very precocious. It is rarer in Europe than either of the other two races.

The ancient breed of English swine was of the Celtic race, but has become modified, especially within the present century, by the introduction of the Iberian and Asiatic races. In consequence of continued crossings all identity has been lost, but it has been observed that certain English breeds, for instance, the Yorkshire, which is one of the most celebrated, has a tendency to revert now to one and now to another of the primitive races, and one individual may show the long snout and pendant ears of the Celtic race, while another shows the short snout and little, erect ears of the Asiatic, or perhaps the black color of the Iberian. The same thing has been observed in the Leicester, Middlesex, and Berkshire breeds.

The Normandy or Angeron breed of swine is the principal one in favor in France and is a pure Celtic animal possessing all the characteristics of that race, except that the usual bony and lean appearance has been done away with through good breeding. Several notable specimens were to be seen upon the Cours la Reine. Good feeding, however, is not the only desideratum for the successful raising of swine, but attention must also be given to cleanliness and to ventilation and proper temperature, particulars which are too often neglected in France as elsewhere.

POULTRY.

France has always been noted for its good poultry-raising, and therefore it was natural to expect a fine poultry show at the Exposition, and this expectation was in no way disappointed. The collection of the more important breeds of common poultry was a very fine one and included Crèvecœurs, Houdans, Cochin Chinas in all their varieties, Brahmas, Dorkings, Spanish, and Hamburgs, together with several native French breeds, mixed breeds, and many foreign ones. Among the latter were the American Plymouth Rocks and Wyandottes.

Complaint has been made that, while the generality of French agriculturalists have paid much attention to obtaining large yields of cereals, or to the breeding of cattle, or to the introduction of new machinery, not enough attention has been paid to poultry, and that the common fowl are left too much to themselves, being allowed to run at large in the farmyards or fields, and pick up miscellaneous food, while young chickens are left entirely to the care of the mother. The rearing of fowl should be more regulated and good breeds should be more generally chosen, instead of, as is often the case, a mixture of all breeds. A chicken of 3 to 4 months, which now sells for 1 franc 50 centimes (30 cents) might, if carefully raised, sell for 4 to 5 francs (80 cents to $1), and from a hundred fowls a profit of 450 francs ($90) might be made annually. Certain breeds should be

chosen for certain purposes; thus the Houdan, Langshan, Crèvecœur, and Bresse breeds are the best for eggs, while the Hamburgs, though esteemed for greater productiveness, lay smaller eggs. The Houdans also are best for fattening, after which come the Faverolles (a French breed) Crèvecœurs, la Flèche, Dorkings, and Bresse. The Langshans and the Cochins are the best setters. Artificial incubation is, however, very much practiced in France (see Class 74). It has been found that artificially hatched chickens, if well fed, will average 1.20 to 1.50 kilos (2.65 to 3.30 pounds) in weight at the age of 3 months, and sell for from 4 to 5 francs each, while ordinary fowls, not so well cared for, sell at the age of 6 months for only 3 to 4 francs apiece.

One or two breeds may be especially mentioned. The Leghorn fowl is of Italian origin, and was imported into America and has since returned to Europe in an improved condition, and is well known in England, Germany, and Belgium, and very common in Denmark, but is comparatively unknown in France. It is a game-looking fowl, with a bright eye and large red crest and graceful figure, and there are four or five varieties of color, red or golden, black, and *coucou* (mottled gray), in all of which the beak and feet are yellow; the hen closely resembles the cock, and is a very good layer. In England the red variety is said to lay about 170 eggs as a yearly average, the white variety laying 160; in Belgium the average is 150 to 200, while in France it has been found to be from 190 to 220. No reason for the fact that this race is not more appreciated in France can be assigned except, perhaps, that its flesh is less esteemed by epicures than that of other varieties.

The *Gascon* or *la Caussade* fowl is a French variety, demanding some attention. The hen is of small size and round figure, and her plumage is entirely black, and the claws are short and of a bluish gray; she is hardy and a good layer. The cock is rather quarrelsome, and although mostly black has white or yellow-red feathers upon his neck, back, and tail. Both sexes have scarlet crest and wattles. It is believed that if the breed were absolutely pure the cocks would also be entirely black like the hens.

Wyandottes were exhibited, but do not seem to be much appreciated in France, though they might be were there not already so many native races there. *Fokshams* and *Phœnix* fowl were also shown as well as game fowl and bantams.

TURKEYS.—Very few were shown, but there were some good specimens of the black, bronze-colored, and white varieties. The hens, however, were all rather old.

GEESE.—The show of geese was large and fine, the principal variety being the Toulouse.

DUCKS.—The show of ducks was also interesting, the principal varieties being the Rouen, Aylesbury, Labrador, and Pekin. The

Rouen ducks were unfortunately molting at the time of the exhibition, but it could be seen that they were stoutly built and otherwise in good condition. The Aylesbury ducks were not particularly fine, neither were the Pekins, but the Labrador ducks were a fine show, and were much admired on account of their beautiful black and olive-green iridescent plumage. The race is hardy and easily reared, and its flesh is much esteemed, having a wild flavor. The ducks are good layers.

PIGEONS.—The show of pigeons was exceptionally fine, and all the important varieties were represented. There were also a few carrier pigeons shown in a "military dovecote," in connection with the exhibit by the minister of war upon the Esplanade des Invalides, besides which there were large flights of carrier pigeons at different times during the Exposition, some of which were sent from the top of the Eiffel Tower. Since the war of 1870-'71 the carrier pigeon has been adopted for use in the French army, a regular service of them being made. They are protected by law, and their indiscriminate possession is forbidden. The type of carrier dove used in France has a strong resemblance to our ordinary pigeon.

GUINEA-FOWLS.—A show of Guinea fowls was made. These birds have been somewhat neglected in France, but are worthy of more serious attention. The common variety, *Numida meleagris*, originates from northern Africa, and a larger variety, the *vulturine*, coming from Madagascar, is to be seen at the Zoölogical Gardens at Marseilles, and is said to be capable of becoming serviceable as a domestic fowl. The ordinary Guinea fowl is as easy to feed as the common fowl, but, being more active, requires greater space to run in.

The hens do not lay in the winter, but in the summer they lay regularly an egg a day. They are not good sitters, and therefore their eggs, which require twenty-eight days to hatch, should be placed under hen turkeys or in the incubator; the young chickens are very lively, but are delicate and require much care. The full-grown fowls are noisy and troublesome, and should be kept separate from the other fowls, but they are brave, and will fight hawks and other enemies. They are susceptible to cold and wet, and should have dry courts and plenty of sunshine. Their flesh is much esteemed, being white, firm, and succulent.

PEA-FOWLS.—None of these were exhibited.

RABBITS.

There was a large show of rabbits, comprising 350 different lots, but beyond a few hundred black Russians there were no new varieties nor remarkable specimens, though an interesting collection was sent from Alsace.

THE HORSE SHOW.

This was held upon the Cour-la-Reine from the 5th to the 11th of September, and was the largest exhibition of horses held in France for 20 years. In 1878, there were 1,058 entries, while in 1889 there were 1,473, and there might easily have been 1,700 had not the opening of the show been delayed for several days.

Horse-raising has improved visibly in France since 1867, and this improvement may be directly traced to the influence of horse fairs and international expositions. A general awakening has taken place, so that now each horse-raising district—Perdie, Boulonnais, Algeria—has its studbook.

The horse show of 1889 was conducted by the *Administration des Haras*, without, as in 1878, the interposition of private individuals. The classification was also an improvement, being by races and not into four sections as formerly. It is said that the total value of the horses exhibited was nearly 20,000,000 francs ($4,000,000).*

Pure-blooded horses were placed in the first category, and consisted of Arabs and English thoroughbreds. The Arabs were only a few in number, eight stallions and five mares, and of these only one stallion was born and raised in France, while six of them came from Syria and one from Rüssia; the mares, however, were all French bred, except the prize mare, which was Russian; the prize stallion was one of the Syrians.

Previous to 1870 few Arab horses were bought by the French, but since that time the stallions have been extensively employed in the National Haras, though private owners are still rare. Arabs are more particularly used in France for military mounts, some of the officers having very fine specimens. Many of the horses called Syrian,

* A notable feature of the show was the absence of foreign exhibitors. In 1878 both Hungary and Russia were well represented, and in 1889 both were absent; there were no animals from Italy, Denmark, or Spain, and the English, though they showed a few draft horses and about twenty half-breeds and trotters, did not do so well as they did at the previous Exposition. A few draft and other horses were sent from the United States, but Belgium was the only country making a serious show. Prizes to the amount of 30,700 francs were offered for blood horses, 64,500 for draft horses, and 11,800 for trotters, in all amounting to 106,700 francs, or over $20,000.

and said to be of Arabian blood, have none of the characteristics of this race whatever.

English Thoroughbreds, or as they are called in France, the English race, were more numerous in 1889 than in 1878, there being sixteen stallions and forty-two mares. Among these were to be seen some horses which had a name upon the turf, such as winners of the annual Grand Prix de Paris, or the Jockey Club prize, and for one splendid specimen, "Stuart," his owner, M. Donon, had recently refused 500,000 francs ($100,000). The prize stallion of the show, "Saxifrage," was a magnificent animal, full of vigor and splendid in form and construction.

Anglo-Arabs.—These were few in number, and did not compare well in quality with those shown in 1878. The breed, however, is steadily growing in favor, although it was at first strongly opposed by many, notably by the Paris Jockey Club, which in 1835 refused to admit pure Arabs to the same consideration as the English race. Later, in 1853, they also proscribed the Anglo-Arab although this breed had by that time become generalized, especially in the south and in the mountainous central districts of France. The Haras law of 1874, however, came to the relief of the breed, and gave, so to speak, official existence to all three varieties, the Arab, the English Thoroughbred, and the Anglo-Arab, and it is precisely this latter variety which is now most appreciated at the Haras, while the English race stands third in favor, though most appreciated by the turf. England does not possess better race horses than France, and the Arabian race is gradually losing its prestige in Europe. The Anglo-Arab is, in fact, steadily increasing in favor, and will, if carefully and scientifically raised, do much toward improving the larger part of the horses of France. The pure Arab will probably never acquire numerical importance in Europe. The pure English is increasing in numbers, but the Anglo-Arab promises better than either of the other two, and will promise better yet, provided its powers are not abused. It would seem that in the Anglo-Arab the two constituting races fortify each other, each supplying what the other lacks, and thus making a more perfect production.

Barbs.—In 1878 this Algerian race was not represented. In 1889, however, there were exhibited five stallions and fourteen mares, most of these coming from the Department of Oran. It is a pity that a more important exhibition could not have been made. This race is very useful as a source of cavalry horses for the French army, for which it is well fitted. The Barb or Barbary horse is not, as has generally been stated, a simple variety of the Arabian horse. It is indigenous to that portion of northern Africa, included in Algeria and Morocco, and was introduced into Europe and well known there long before the advent of the Arabian, and in the reign of Henry VIII was in especial favor in England.

When the French invaded Algeria in 1830 the Barb was the pre-

dominant race there, and the nomad life of the natives had contributed to its development, making it of great strength, swiftness, and endurance. The war which followed and the consequent famine and ruin of the Arab chiefs, and especially the admixture of foreign races, brought about a degeneration, which has since been but partially remedied. There were in 1888, in Algeria, 171,562 horses, of which 139,820 were of the native race and 31,742 were foreign. Notwithstanding this large number of native horses and the opportunities offered by the country, horse-raising does not flourish in Algeria as it should: many of the colonists do not cover expenses and the native breeders are the only successful ones.

The *Service des Remontes Militaires*, which in Algeria occupies the same position as the Haras administration in France, has done all it could in the way of trying to introduce new blood by means of well chosen stallions coming from France, and the ministry of agriculture has occupied itself in the same direction, but these efforts have been of no avail. The true remedy is to be found not in the introduction of new blood but in judicious matching in the same race, appropriate hygiene, and better feeding. Thus the war horse, agricultural horse, or horse for general use may be obtained in an improved condition. Crossing is only necessary for the production of the very finest animals, and it should never be done except with animals of similar race, such as the Arab, the Anglo-Arab, or the thoroughbred English, or even the Pyrenees race, all of which have more or less oriental blood in their veins.

The true Barb stands about 1.50 meters (4 feet 11 inches, or 14 hands 3 inches) in height and has a spare head, thin lips, and small mouth. The eye is large and the expression is calm in repose, but animated while in motion; the shoulders are strong and the withers high and thick, while the back and loins are short and broad, and the croup is also short and sloping; the tail is badly attached and the thighs are thin; the limbs are remarkably long and strong, and are not always irreproachably straight, especially the hinder ones, but these faults are compensated by hardiness, vigor, and endurance.

The Barb differs then from the Arabian in having a short back, loins, and croup and long and not particularly straight limbs and in not having such general beauty of form. The race has degenerated, though not so much as not to be still easily susceptible of improvement.

French cross-bred Horses or Half-bloods.—These breeds, generally crosses of the English thoroughbred with the native French Normandy, Vendeau, Saintonge, or other races, are much esteemed in the countries bordering upon France as improvers of ordinary stock.

A magnificent show of them was made, there being no less than 806 entries. Among these the best improvement was to be seen

among the Anglo-Normans. Formerly but little care was taken in Normandy in horse-raising of this class, but of late improvement has been made year by year, until now these horses are all that can be desired. There is no definite type of pure Norman horse. At certain localities in that country, for instance upon the plains around Caen, horses are raised, but not bred, the breeding being done in the Cotentin, Bessin, or the valley of the Ange and the colts being sent to Caen while quite young. At Merlerault (Orne), however, the farmers produce and raise their own colts. The Cotentin horses are especially valued for fine carriage horses. This particular breed having been anciently crossed with Spanish and Danish races had acquired undesirable form of head, which it has since lost through crossing with the English race.

Poitou and the Charentes also sent fine carriage horses, which all showed the influence of the rich pastures of those regions.

The Marais mares were especially admired, but the stallions of the same breeding are not so successful, and the Anglo-Norman stallion should be employed there. The Breton horses were wonderfully good and surprising progress was shown, especially in *chevaux de luxe* closely resembling the Anglo-Normans and mostly coming from Finisterre. Progress was also manifested in the horses sent from Limousin and the Hautes-Pyrénées.

The French trotters belong to the category of half-bloods as also do all the circus and hippodrome horses in France. Of trotting horses there was a good exhibit of eleven stallions and fourteen mares, mostly from Normandy. There were, however, no Russian or American trotters, which was to be regretted, as the American trotter would easily have taken first rank. Such were evidently expected, however, as the conditions of entry for trotters stated that both stallions and mares must have won at public races at least the sum of 3,000 francs ($600) and must have made records as follows: French horses, a kilometer in 1 minute 50 seconds. English and Americans, a mile (1,609 meters) in 2 minutes 57 seconds. Russians, a verst (1,066 meters) in 1 minute 57 seconds. Trotting was formerly sneered at by the Jockey Club, but now it is almost as common as ordinary racing. France does not as yet possess a properly so-called trotting race such as exists in the United States, but will eventually have one, and trotting genealogies are now kept.

Draft Horses.—The show of these was particularly important, as it also was in 1878. Draft horses were divided into eight categories, classed according to age, sex, and stature, and contributions were made from England, Belgium, and France. The English horses were very uniform in size and were very large, but the Clydesdales have flat and poor hoofs, and seem to be made to walk upon soft ground only. The Belgian horses are not less large than the English and have no better hoofs and do not seem any better suited for

use in France, especially for the miscellaneous work required there. The Percheron and Boulonnais French breeds are altogether the best adapted to France. They are less bulky than the English or Belgians, but make up for this by firmer muscles and greater energy. They also make excellent omnibus and tramway horses, and for heavy carting they have better feet for city pavements than either of the above races.

The Percheron and Boulonnais races show evident remains of Arabian blood. This crossing doubtless goes back to the Crusades, and is indelible; the size and form shows it, as well as the gray color—that of the original Arabian. These races were long used in France for the diligence service and post horses of their calling. Therefore attention was turned to rendering them larger and stronger for heavy carting. Foreign purchasers, especially Americans, bought them only by weight, and it would be regretable if such a custom, in going too far, should tend to deteriorate the race so that it should loose all aptitude for omnibus or artillery service. Certain Boulonnais stallions, kept in their purity, gained the first prize in 1878 for draft horses.

In 1889 it would seem that the Percheron was much below the standard, and that the light draft horse existed, so to speak, no longer. Tempted by large prices the Percheron stock-raisers sought to produce size and corpulence to the detriment of other qualities, so that the fine post-horse of other days was in danger of becoming extinct.

The Boulonnais race, however, is making great progress, and it is not with them as it is with the Percherons. Raisers understood what was needed and their stock has gained in lightness and in general appearanee what has been lost in corpulence. These horses are just large and stout enough to meet all requirements and nothing more, and yet their size does not deprive them of good conformation or of good temper. Some of the animals shown measured 1.66 meters (5 feet 5 inches or 16 hands 1 inch high), and were very muscular, yet had wonderful suppleness and energy. Their good temper comes from their healthy structure and good grain feeding. They are allowed to work at the age of 18 months and do not grow after the age of 3 years. They have strong heads and bright eyes and short but very thick manes; the chest is deep and muscular, the shoulders large, and the body low on the legs. Dapple gray is the most usual color, though there are many roans and bays.

The show of Belgian draft horses was a successful one, since horse-raising has made much progress in that country of late years. The principal races shown were the Ardennes and the Belgian. The former is common in France as well; yet out of 61 in the class (37 stallions and 24 mares) only 23 were owned in France, while all the gold medals went to Belgium.

Some years ago it was said that the Ardennes race was degenerating through defective raising and imperfect feeding. An improvement, however, was to be noticed in 1889 and the bad points are beginning to disappear.

The old names of Brahancon and Flemish horse seem to be now done away with and the two distinctions to be united and the name Belgian race to be given to the whole. There were 89 of these Belgians at the Exposition—47 stallions and 42 mares.

The English show in this class was disappointing. There were only a few Clydesdales and one Shire horse. This last variety is a comparatively new creation and is very large and strong and has the legs furnished with long hair. It is generally of a bay or black color, and seems to be much appreciated in the large English towns. One colossal Clydesdale, "Bloomsbury," was noticed, owned in Kansas. Clydesdales are much in favor in Canada and Australia. No Suffolk Punches were shown.

The show of donkeys and mules was very small, and nothing noteworthy was presented. The industry of mule-raising is a large one in France, however, especially in Poitou.

PART II.

REPORTS

ON

THE U. S. AGRICULTURAL EXHIBIT,

AND ON THE

AGRICULTURAL PRODUCTS OF THE UNITED STATES.

Prepared, under direction of the Secretary of Agriculture,

BY

CHARLES V. RILEY, Ph. D.,

REPRESENTATIVE IN CHARGE,

AND

A CORPS OF EXPERT ASSISTANTS.

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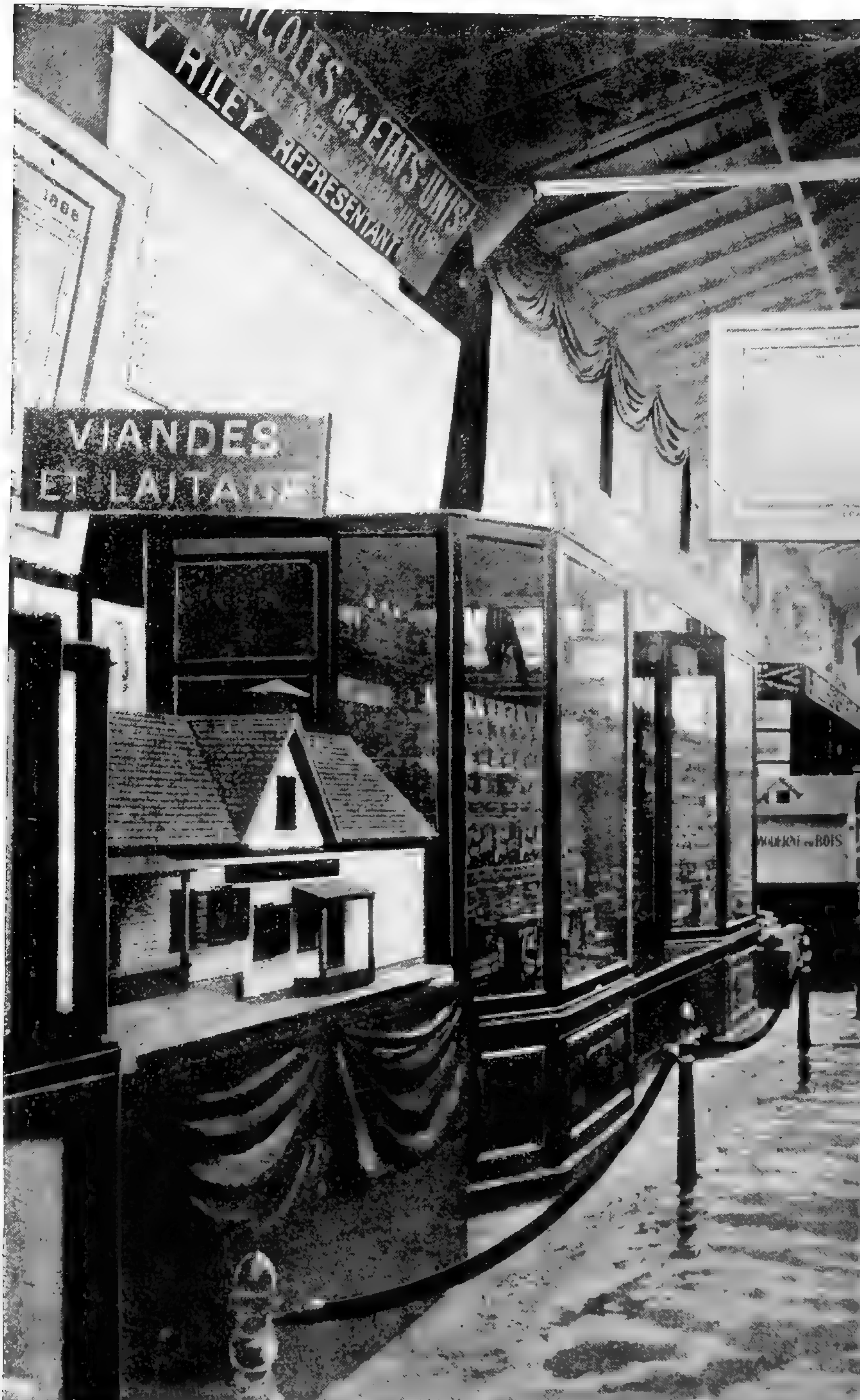

CENTRAL SECTION OF UNITED

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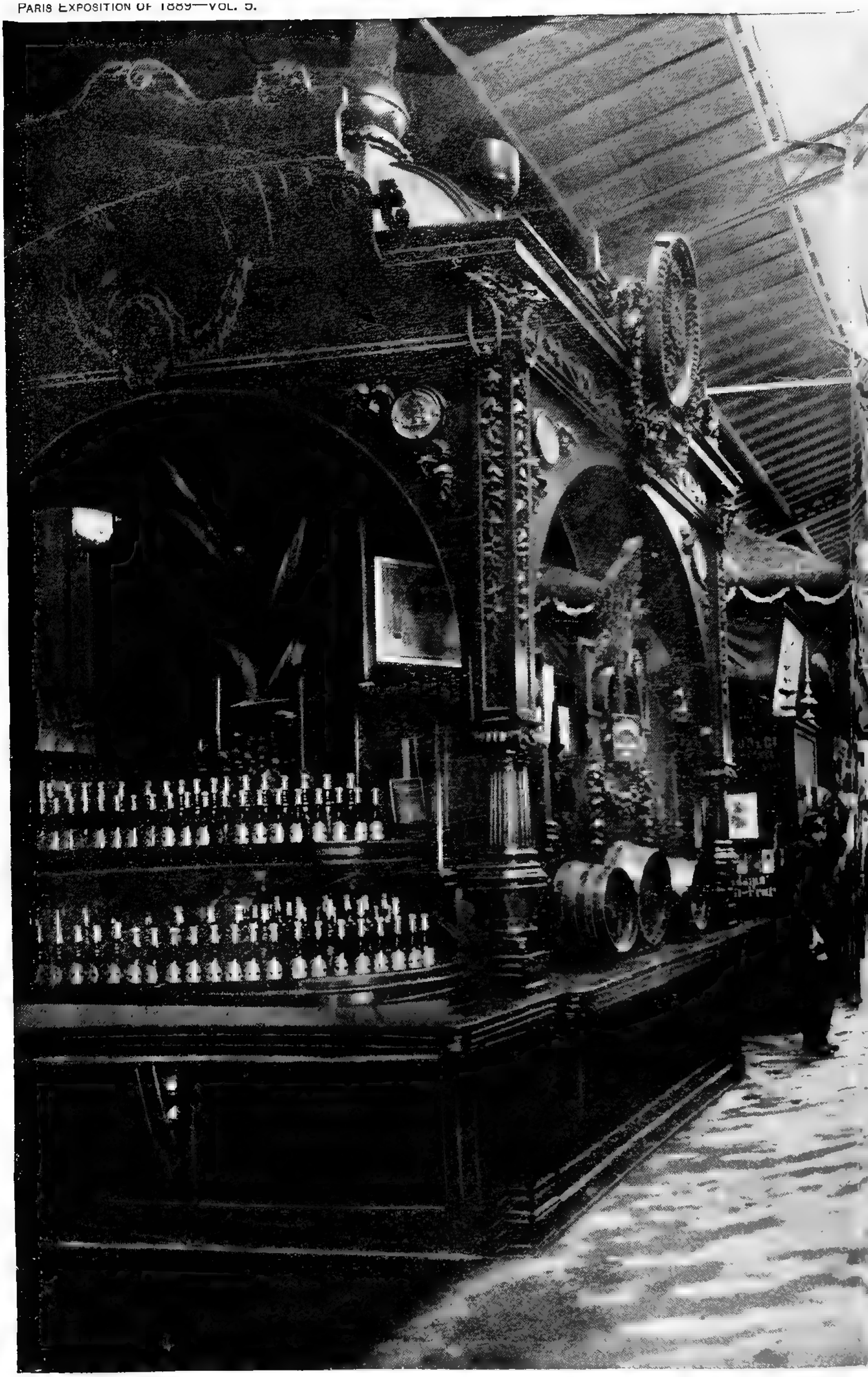


REAR VIEW OF UNITED STATES

S AGRICULTURAL EXHIBIT.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., May 30, 1890.

SIR: I have the honor to transmit herewith the following reports relating to the exhibit of the agricultural products of the United States at the Paris Exposition of 1889. These reports should properly form a part of the general report on the Paris Exposition which is being prepared in your Department for publication, by Gen. William B. Franklin, United States Commissioner-General at that Exposition. They include, first, a brief history, by Dr. C. V. Riley, Representative in Charge, of the preparation of the exhibit, and a full list of the articles exhibited, made by this Department in accordance with the act of Congress making the necessary appropriation for the representation of this country at that Exposition, which especially enjoined upon the head of this Department the duty of preparing an exhibit of the agricultural products of the United States, and requiring that the same be accompanied by a report upon our agricultural products, specially prepared for the purpose, and intended for translation and distribution abroad; which reports were duly handed over to the Commissioner-General, March 26, 1889, for said purpose.

I also transmit herewith a Report upon the International Congress of Agriculture, held at Paris during the Exposition, prepared by Dr. C. V. Riley, who was its representative delegate at that Congress. This Congress having been held in connection with the Exposition, it will no doubt be found desirable to include it in that volume of the general report devoted especially to agriculture.

The special reports pertaining to the Meat and Dairy Products were prepared under the direction of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry of this Department. The Report on Economic Entomology was prepared by Dr. C. V. Riley, Entomologist of the Department, with the aid of Mr. Philip Walker, at that time in charge of the Silk reeling, and Mr. C. L. Marlatt, one of the assistant entomologists. The Reports on the Cereal Products were prepared by Mr. Geo. Wm. Hill and Mr. Milton Whitney, and that on Vegetables by Mr. M. G. Kern; that on Fruits, by Prof. H. E. Van Deman, Pomologist of this Department, and that on Viticulture, by Messrs. Geo. Husmann and B. F. Clayton. The Report on Sugar and Sirups was prepared by Prof. H. W. Wiley, Chief Chemist of this Department; that on Textile Fibers, by Mr. Charles Richards Dodge, and that on Tobacco and Peanuts, by Mr.

Alexander McDonald; the Report on Forage Plants and Grasses, by Dr. Geo. Vasey, Botanist of this Department, and that on Ensilage, by Herbert Myrick; the Report on Forestry, by Prof. B. E. Fernow, Chief of the Division of Forestry; the Report on Ornithology and Mammalogy, by Dr. C. Hart Merriam, Chief of the Division having charge of this work; the Report on Food Adulteration, by Dr. Thomas Taylor, Microscopist of this Department; the Report on Fungous Diseases, by Prof. B. T. Galloway, then Chief of the Section, now the Division, of Vegetable Pathology; the Report on Agricultural Statistics, by Mr. J. R. Dodge, Statistician of the Department, and the Report on Agricultural Science and Education, by Mr. A. C. True, of this Department, under the direction of Prof. W. O. Atwater, then Director of the Office of Experiment Stations.

I have the honor to remain, your obedient servant,

J. M. RUSK, *Secretary.*

The Honorable, The SECRETARY OF STATE.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., May 30, 1890.

SIR: In pursuance of authority granted me by Commissioner Colman, October 6, 1888, by him as Secretary, February 2, 1889, and confirmed and extended by yourself, March 19, 1889, I submit herewith my report, as Representative in Charge, on the agricultural exhibit of this Department at the Paris Universal Exposition of 1889. I submit this report in the form of a brief history of the exhibit, together with an account of the International Congress of Agriculture held at Paris during the Exposition, which I attended as the representative delegate of this Department. To these I have attached as appendices a full list of the articles exhibited, and sundry circulars and documents necessary to complete the history of the work of preparation. I have also added copies of articles relating to the exhibit, taken from "Le Temps" and the London "Morning Post," because of their critical nature and the high authority of the writers thereof. I recommend the publication of these reports, which, in connection with the special reports on the agricultural resources of the United States, prepared in accordance with the act of Congress respecting our agricultural productions, made by officers of this Department and other specialists engaged for the purpose, will form a comprehensive account of the agricultural exhibit.

I have the honor to remain, yours, respectfully,

C. V. RILEY,
Representative in Charge.

Hon. J. M. RUSK, *Secretary of Agriculture.*

SECTION I.

REPORT

ON THE

AGRICULTURAL EXHIBIT OF THE UNITED STATES,

AND ON THE

INTERNATIONAL AGRICULTURAL CONGRESS.

CHAPTER IX.

BRIEF HISTORY OF THE EXHIBIT.

By C. V. RILEY.

The joint resolution of Congress approved May 10, 1888, by which the United States accepted the invitation of the Republic of France to take part in the Universal Exposition to be held in Paris, provided among other things that the Commissioner of Agriculture be authorized to "collect and prepare suitable specimens of the agricultural productions of the several States and Territories of the Union for exhibition at the Paris Exposition and to accompany the same with a report respecting such productions, to be printed in the English, French, and German languages, the expense of the same to be paid out of such appropriation."

This resolution made it necessary to determine in advance what amount from the general appropriation should be allotted for the purpose indicated, as also the general plan of the agricultural exhibit. No definite arrangement or understanding had been arrived at in September when Commissioner Colman expressed the desire that I take charge of the collection and preparation of the material for the Paris Exposition. I at once entered earnestly into the project and an agreement was soon arrived at between Commissioner-General Franklin and Commissioner Colman and ratified by the Secretary of State, both as to the general plan and the amount to be allotted for the purpose. Correspondence was also at once begun with a view of organizing the force to be employed and on October 6 I was formally appointed by Commissioner Colman as his representative to act for him in all matters pertaining to such preparations.

It was late in the season to begin the preparation of such an agricultural exhibit; there were many difficult details to settle and we were in the midst of a Presidential election which greatly distracted our people and rendered the task of collecting somewhat more difficult than it otherwise would have been.

Notwithstanding these adverse circumstances the work was vigorously prosecuted in accordance with the general regulations laid down by the authorities in Paris and those which General Franklin found it necessary to make.

The circulars sent out (copies of which are added as Appendices I, II, and III,) will more fully indicate the purpose and scope of the work and the parties appointed to assist in it; while the following scheme will show the general classification adopted:

General Classification of the Exhibit of agricultural Products of the United States at the Paris Exposition of 1889.

DIVISION 1.—*Animal Products.*

SEC. I. Meat and Dairy Products.
Subsec. A. Packed and Cured Meats.
B. Canned Meats and Soups.
C. Dairy Products.
D. Models.

SEC. II. Economic Entomology.
Subsec. A. Apiculture.
B. Sericiculture.
C. Insects, Injurious and Beneficial.
D. Insecticides.
E. Insecticide Appliances.

DIVISION 2.—*Food Substances of Vegetable Origin.*

SEC. III. Cereal Products.
Subsec. A. Cereals in the Ear.
B. Cereals in the Grain.
C. Farinaceous Substances.
D. Rice.

SEC. IV. Vegetables.
Subsec. A. Legumes.
B. Potatoes.
C. Onions.
D. Roots.
E. Hops.
F. Castor Beans and Oil.
G. Canned Vegetables.
H. Miscellaneous Exhibits.

SEC. V. Fruits and Nuts.
Subsec. A. Citrus Fruits.
B. Subtropical Fruits.
C. Orchard Fruits.
D. Small Fruits.
E. Nuts.
F. Dried Fruits.
G. Preserved Fruits.

SEC. VI. Viticulture.
Subsec. A. Grape Vines and Roots.
B. Culture and Manufacture.
C. Condensed Grape Must.
D. Wines and Brandies.
E. Raisins, and Dried Wine Grapes.

SEC. VII. Sugars and Sirups.
Subsec. A. Sugar-Producing Plants.
B. Sorghum Sugar and Molasses.
C. Cane Sugar and Sirups.
D. Beet Sugar.
E. Maple Sugar.
F. Manufacture.

DIVISION 3.—*Commercial Vegetable Products other than Foods.*

SEC. VIII. Textile Fibers.
Subsec. A. Wool, (necessarily grouped here.)
B. Cotton.
C. Flax and Hemp.
D. Ramie and Jute.
E. Mallow Fibers,
F. Leaf Fibers.
G. Miscellaneous fibrous Material.

SEC. IX. Tobacco.
Subsec. A. Varieties of Leaf.
B. Manufacture.

SEC. X. Forage Plants and Grasses.
Subsec. A. Forage Plants.
B. Baled Hay.
C. Ensilage.
D. Grasses Proper.

SEC. XI. Forestry.
Subsec. A. Forest Botany.
B. Forestry Proper.
C. Forest Utilization.

DIVISION 4.—*Educational Exhibits.*

SEC. XII. Economic Ornithology and Mammalogy.

SEC. XIII. Food Adulteration.
Subsec. A. Butter and Fats.
B. Condiments.
C. Microscopic Instruments used for the detection of adulterants.

SEC. XIV. Fungus Diseases of Plants.

SEC. XV. Agricultural Statistics.

SEC. XVI. Agricultural Science and Education.
Subsec. A. Schools.
B. Experiment Stations.

It had been decided by the authorities that, while the Commissioner of Agriculture should have entire control of expenditures and of all details in the preparation of the exhibit and its shipment to New York, within the limits of the sum allotted for that purpose, yet that after leaving New York he would have no further responsibility in the matter and nothing to do with the installation. This arrangement, it need hardly be said, rendered it extremely difficult to insure success and necessitated much greater attention to details in Washington than would have been necessary had the preparation and installation of the exhibit been under the same management. Indeed, had it not been for Gen. Franklin's recession to some extent from this decision there could have been no successful carrying out of the scheme adopted on this side of the Atlantic. By this recession it was arranged to send over with and in charge of the principal shipments Messrs. F. T. Bickford and John Darr who had been made familiar with the general plan of installation, as well as with the contents of each case; while later on Mr. Charles Richards Dodge and Prof. James Cheeseman were sent over to still further assist in the installation and care of the collection.

After having seen nearly everything duly shipped, I sailed on the 13th of April, leaving Mr. William Saunders in charge with due authority to act in respect of such matters as yet needed attention.

Though the time of formal opening of the Exposition was fast drawing near I found upon my arrival in Paris—and this is the history of almost all exhibitions—that everything was in great confusion and behindhand. This was equally true, though through no fault of those connected with it, of our agricultural exhibit; but by the 6th of May, when the formal opening took place, it was more forward than most of those of a similar nature.

It would hardly be profitable to go into details as to the experience of the following five months. A universal exposition is a world in miniature and is well calculated to bring out the various phases of human character. With innumerable difficulties to overcome (not peculiar to our agricultural exhibit, but attaching to all departments of the Exposition), perhaps the most serious which we had to contend with was the very restricted area originally allotted to us and the reduction of this by one-third, after all our plans had been made on the previous scale; while the most discouraging features in connection with our exhibit was, that, while everybody abroad was praising it, some of our own papers were publishing criticisms based upon a misapprehension of the facts. In this connection I may be pardoned for referring with some pride to the list of awards (Appendix V), the summary of which shows 7 grand prizes, 40 gold medals, 68 silver medals, 54 bronze medals, and 39 honorable mentions, while the comparison of these with the awards in the same classes at previous expositions must needs be gratifying to all concerned in the late exhibit.

All the foreign press comments on our exhibit that came to my notice were most gratifying, while some journals devoted column after column to a review of it. Two of these are noteworthy, viz, the series of articles in *Le Temps*, by M. Léon Grandeau, probably the ablest agricultural writer in France, and the series in the London *Morning Post*, by Prof. H. Fream, also one of the ablest English lish writers on agricultural subjects. These articles are in themselves so interesting, not only as reviews of our exhibit, but for the opinions and reflections which they embody, from French and English standpoints, that I have reproduced them whole or in part in Appendix VI, with no attempt to alter slight inaccuracies.

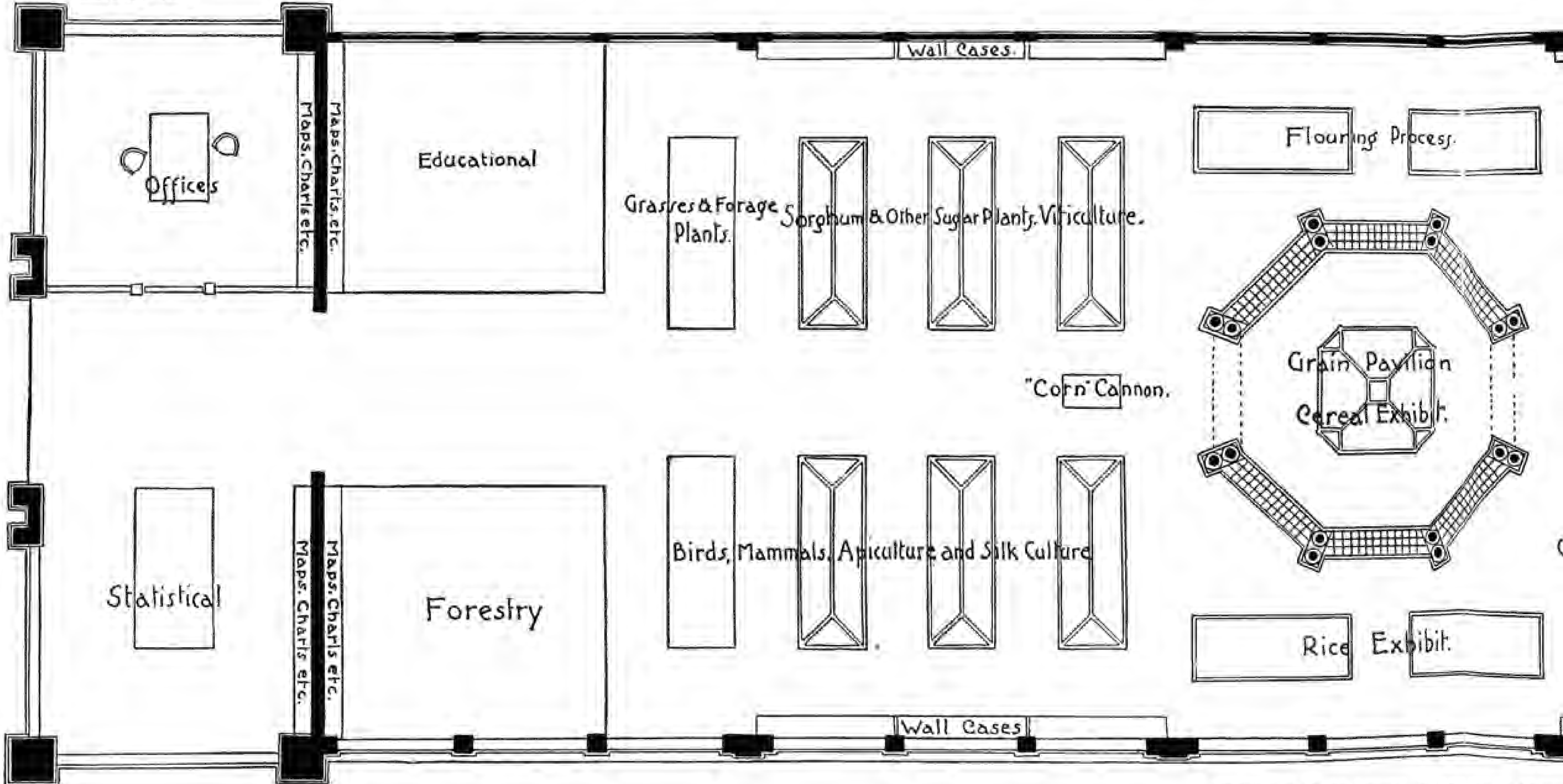
The three views of the exhibit given in this report were made from photographs that were difficult to take successfully on account of the light, but they will convey some idea of the general appearance of the exhibit, showing, as they do, the front entrance (frontispiece to volume), a central section, showing one side of the refrigerator to the right, and a view from the rear. A view of the agricultural machinery is given in Vol. I. I have also introduced two ground plans, the one indicating that designed after the original allotment of space, the other illustrating the modification made necessary by subsequent restriction of space and the actual disposition of the exhibit as finally arranged.

The agricultural exhibits occupied the entire length of the Quai d'Orsay, and while, as compared with other countries, we were third as to the space assigned, we had barely one-tenth the amount occupied by France.

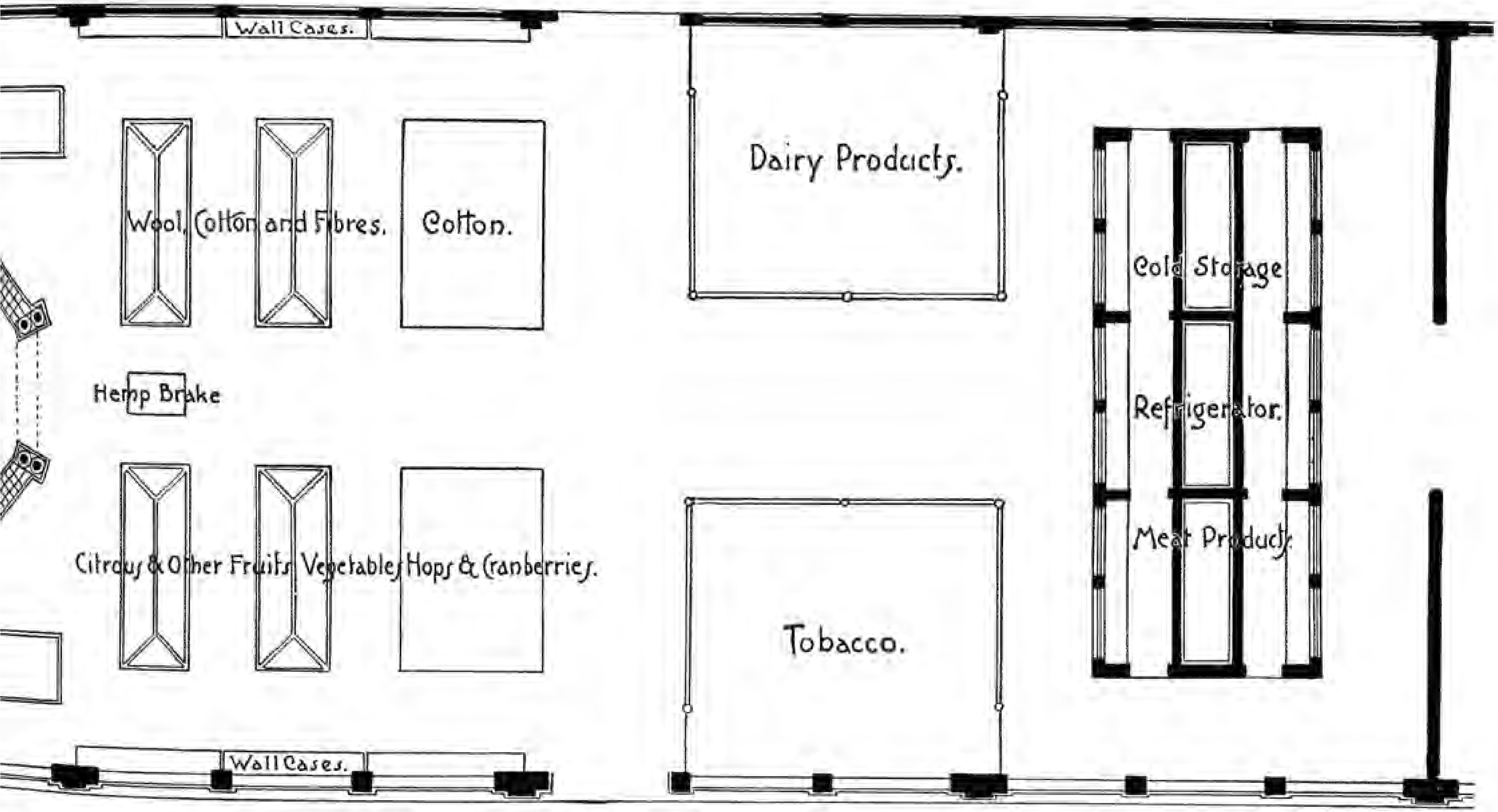
The total number of cases shipped from Washington was 573, with an aggregate of 4,706 cubic feet. This was exclusive of heavy shipments direct to New York, especially of meats and meat products from Chicago and of wines and other material from California. The sum originally agreed upon between Commissioner-General Franklin and Commissioner Colman for this exhibit was $47,000; subsequently reduced by the State Department to $38,000. The actual amount expended, including payments on return shipments to parties who merely loaned their material, was $32,438.54, leaving a balance not drawn upon in the commissioner-general's hands of $5,561.46.

This work could not have been carried on with such economy had it not been that so many of the gentlemen who assisted in it were connected with the Department and received no compensation for their services, and that the Department, as also the U. S. National Museum, contributed in the way of cases and exhibit material from their permanent exhibit stock.

One of the first questions to be decided, affecting as it did so materially the sum to be used by the Secretary of Agriculture, was as to the intent and requirements of the law in reference to the publication of a report in English, French, and German. It was decided by the commissioner-general that the duty of the Commissioner of



GROUND PLAN OF EXHIBIT, AS ORIGINALLY DESIG



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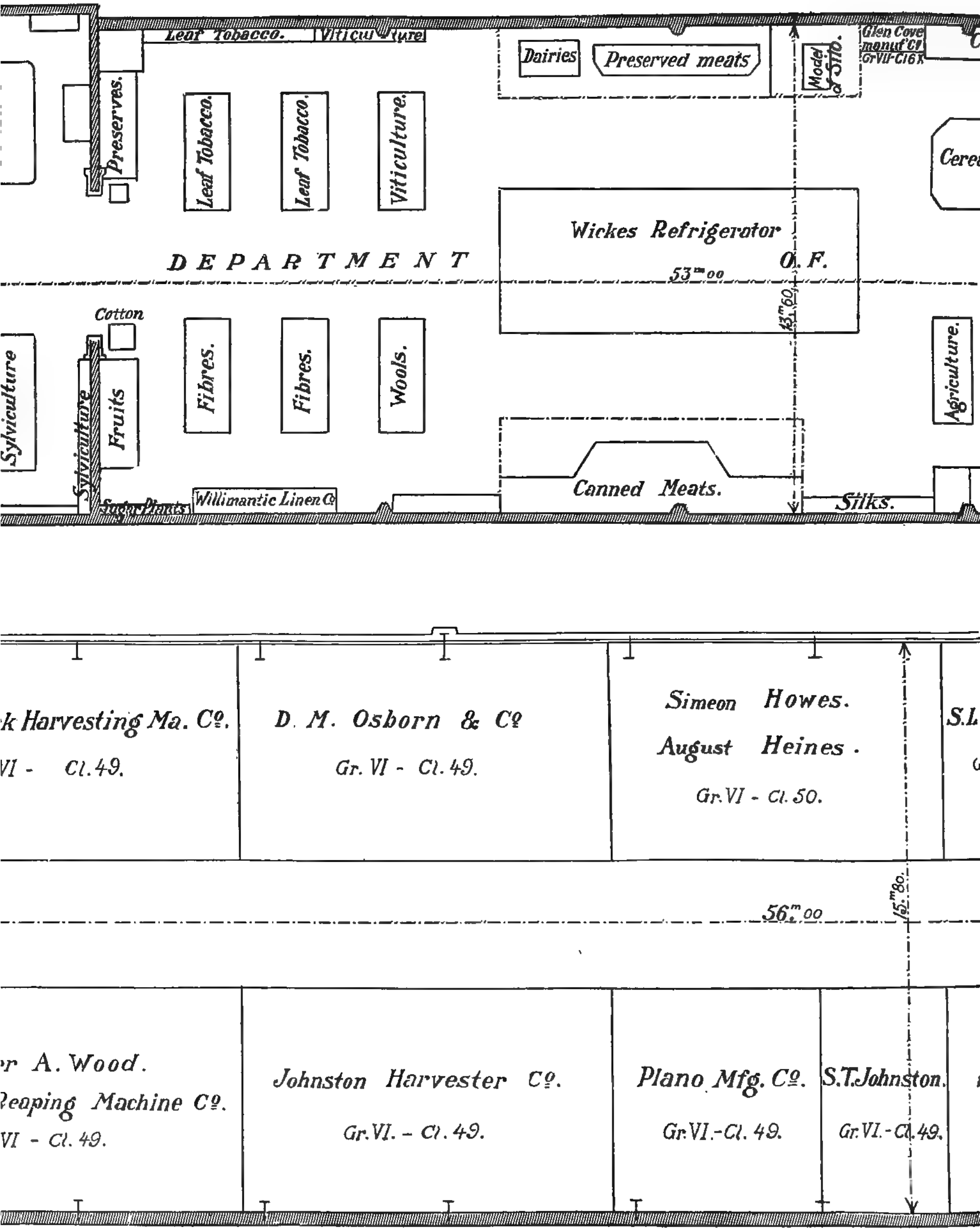
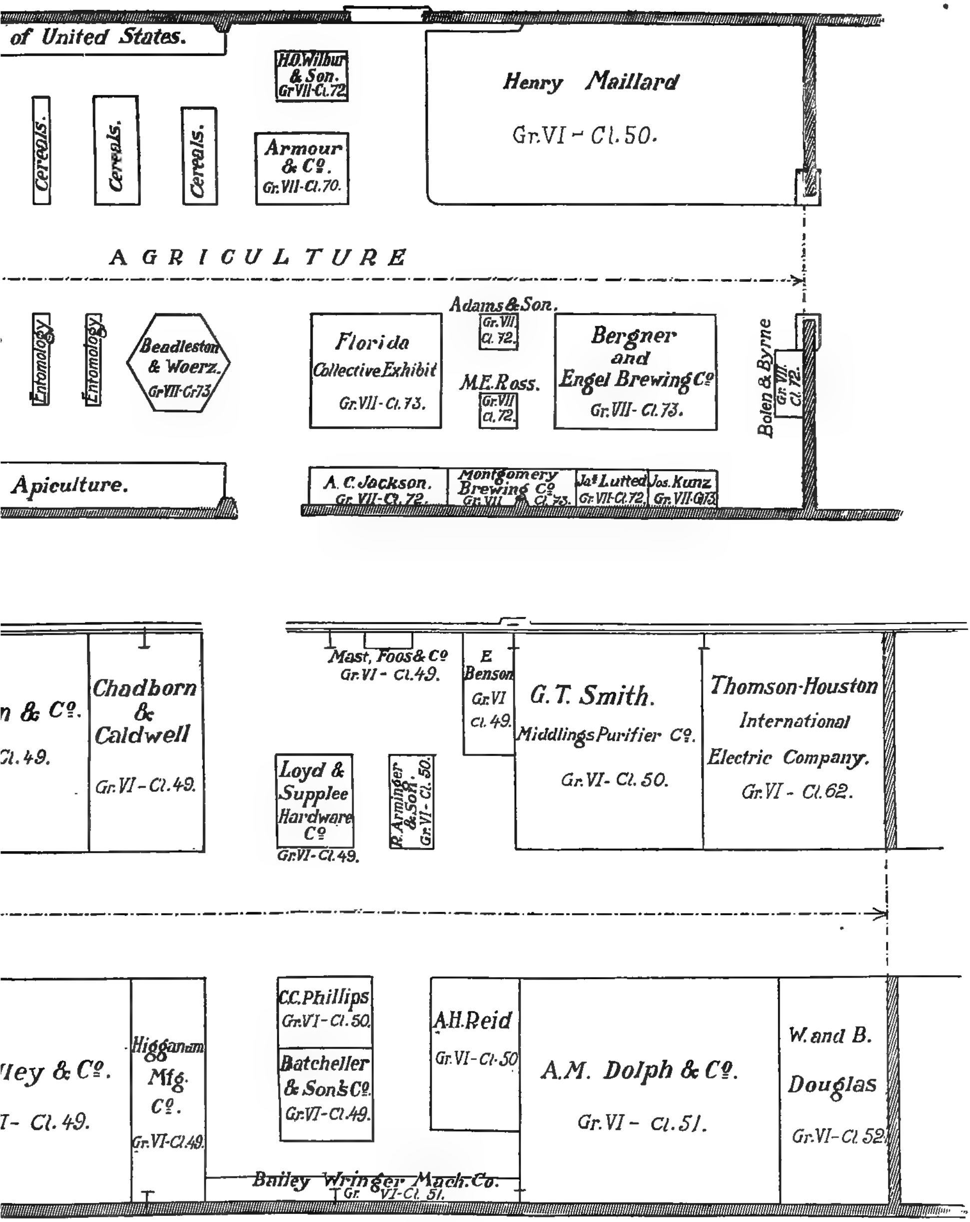


GROUND PLAN OF EXHIBIT


of United States.
H.O. Wilbur & Son. Gr. VII-Cl. 72
Henry Maillard
Gr. VI - Cl. 50.
Cereals.
Cereals.
Cereals.
Armour & Co. Gr. VII-Cl. 70.
AGRICULTURE
Adams & Son. Gr. VII Cl. 72.
Entomology
Entomology
Beadleston & Woerz. Gr VII-Cl 73
Florida Collective Exhibit Gr. VII - Cl. 73.
M.E. Ross. Gr. VII Cl. 72.
Bergner and Engel Brewing Co Gr. VII - Cl. 73.
Bolen & Byrne Gr. VII. Cl. 72.
Apiculture.
A. C. Jackson. Gr. VII-Cl. 72.
Montgomery Brewing Co. Gr. VII Cl. 73.
Jas Lutted Gr. VII-Cl. 72.
Jos. Kunz Gr. VII-Cl. 73.
n & Co.
Cl. 49.
Chadborn & Caldwell
Gr. VI - Cl. 49.
Mast, Foos & Co Gr. VI - Cl. 49.
E. Benson Gr. VI Cl. 49.
G. T. Smith. Middlings Purifier Co.
Gr. VI - Cl. 50.
Thomson-Houston International Electric Company.
Gr. VI - Cl. 62.
Loyd & Supplee Hardware Co
Gr. VI - Cl. 49.
R. Arminger & Son. Gr. VI - Cl. 50.
ley & Co.
I - Cl. 49.
Higganum Mfg. Co.
Gr. VI-Cl. 49.
C.C. Phillips Gr. VI - Cl. 50.
Batcheller & Sons Co. Gr. VI - Cl. 49.
A.H. Reid Gr. VI - Cl. 50
A.M. Dolph & Co.
Gr. VI - Cl. 51.
W. and B. Douglas
Gr. VI - Cl. 52.
Bailey Wringer Mach. Co. Gr. VI - Cl. 51.

ADOPTED.

Agriculture ceased with the preparation of the report in English, and that the Commission should take entire charge of translation and publication. A French abridged edition was published and distributed during the Exposition, and, with the view of saving space, the abridged English copy has for the most part been used in this report.*

In connection with the meat exhibit, the larger dealers in meat, through their agents, especially the Messrs. Armour & Co., through Gabain Frères, at Havre, made every effort during the Exposition to influence the French Government to withdraw the restrictive duties against American pork products. I had considerable correspondence with these different gentlemen in the matter, and several interviews with Minister Reid looking to this desired end, feeling as I did that this was one of the most important results to be attained, and recognizing that nothing should be left undone in connection with the exhibits and the reports to educate French people as to the excellence and healthfulness of the meat products of this country.

In this connection I should feel derelict did I not point out the two chief factors which have given rise to some difficulty and added materially to the task assigned by Congress to the Commissioner of Agriculture. They are both connected with defects in the resolution as passed by Congress, and it is earnestly to be hoped that in case of future similar international expositions these two difficulties may be avoided by a more carefully drafted resolution. First, it would be very much more satisfactory and avoid much delay and misunderstanding if, in future bills of this nature, a definite sum out of the appropriation be assigned to the Secretary of Agriculture in connection with the work required of him; secondly, it would very greatly facilitate the work and permit its more perfect and harmonious planning and carrying out if, in future, the Department should have, within the limits of the law and whatever general regulations may be laid down, complete charge of and responsibility for both the preparation and the installation of the exhibit.

The International Agricultural Congress, which was held from July 4–11 inclusive, was one of the most successful and largely attended congresses held during the Exposition, concluding with a grand banquet at the Hotel Continental. The attendance was large at all the general sessions and at the sectional meetings, and all the chief countries of the world were represented.

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*Since this was written and the report placed in the printer's hands, the papers prepared under Dr. Salmon's direction on the meat industries have been published as part of the Fourth and Fifth Reports of the Bureau of Animal Industry for the years 1887 and 1888. They could not well be omitted from this report, in which they belong, the plates having been already prepared and numbered, but their value otherwise justifies the wider circulation which Dr. Salmon has given them.

In the report of the proceedings I have endeavored to present in condensed form those results of the deliberations of the Congress which will prove of most importance to our people. These include points from the address of President Méline on the status of European, and especially French, agriculture; the question of agricultural credit; State assistance; the parceling of the soil; rights of tenants; the consideration of agriculture in the different countries represented; and agricultural education. I have also given a summary of the deliberations on the sugar beet and the sugar industry, on distilling by farmers, and on cider and dairy matters, together with an account of the instructive visits which the Congress made to the seed-growing establishment of Vilmorin, Andrieux & Cie, at Verrières le Brisson, and to the Arcy experimental farm. I have passed with a few words the deliberations on viticulture and sericiculture, as these subjects are treated quite fully in my report as expert on Group VIII. As it was impossible to give attention to all the sections, I have made no effort to report on the questions of bird protection, the control of rodents, fish and oyster culture, and some other matters, believing that from the very different conditions which affect these questions with us, as compared with other parts of the world, they were of less interest to our farmers.

Those parts of the exhibit which were of a perishable nature were left in Europe, having been donated either to charitable institutions or to the Museum of Agriculture and the Jardin des Plantes. The bulk of that having more permanent educational value was brought back and either shipped to parties who had exhibited with that understanding or deposited either in the Department Museum or the National Museum.

In closing, my sincere thanks are offered to the gentlemen associated with me for the part they have taken, whether in the exhibit or the preparation of the report, and who have so lightened the task. My acknowledgments are also due to many others not mentioned in the report (see Appendix II) who have in various ways aided in the work; and if I emphasize a few names it is from a sense of deeper obligation to the parties: Mr. Charles Richards Dodge has been of the greatest service, both in the preparation of the exhibit in this country and the installation in Paris. Prof. James Cheeseman was also of the greatest service in dairy and meat matters. Both these gentlemen acted in addition as jurymen, and assisted, with Mr. Amory Austin, in the general office work. Mr. George William Hill, in addition to his special work on the cereals, has aided very materially in the general work of preparation. Mr. William Saunders's experience and advice have been invaluable. He superintended the packing and, in connection with Mr. William Trimble and Mr. Hill, took charge of matters at Washington during my absence. Lastly, the experience of Mr. John Darr was invaluable both in packing,

unpacking, and installation of the material. His sad and sudden death, on the 11th of August, was deeply mourned by all connected with the exhibit, and Mr. W. E. Humphrey, who was sent over in his place to repack the material for return shipment to this country, made the best of a very difficult task.

CHAPTER X.

INTERNATIONAL CONGRESS OF AGRICULTURE.

By C. V. RILEY.

THE CRISIS IN AGRICULTURE.

I. The International Congress of Agriculture was held from the 4th to the 11th of July. It was presided over by M. Jules Méline, president of the Chamber of Deputies and ex-minister of agriculture, and there were over 1,400 members present, delegates having been sent from nearly all the leading countries, even including Prussia and other German States.

In his opening address M. Méline referred to the fact that never had an agricultural congress been of more vital interest to the future welfare of the people, and never had it been more necessary for scientists, agriculturists, and economists to meet and deliberate upon the causes and effects of the great economic revolution then in progress. This revolution barely commenced to show its effects at the time of the Exposition of 1878, but since that period it has greatly increased. At that time the agricultural market of each country had only to compete with a limited number of neighboring markets, the extent of the production of which was perfectly understood, so that international exchanges might be easily calculated in advance. Since that time and in the space of a very few years, means of communication have by the improvements and extension of railways, canals, and telegraph lines so enormously increased and the price of transportation has in consequence so diminished that the various markets have virtually been brought closer together and in fact the world itself may be considered as one vast market. The effects of such a revolution upon agricultural industry were inevitable. New nations with virgin soil produce crops with very little effort at cultivation and almost without expense, and their production is far in advance of the needs of their sparsely settled population, so that older and more thickly settled countries, where the soil is more or less exhausted by long cultivation, can not

compete with them, and thus the principal source of production and revenues of these older countries—their agriculture—is menaced. How is this danger to Europe to be avoided, and what is to become of her usual population if the tilling of the soil be no longer remunerative? How is the agriculture of France to be made remunerative and emigration to more fertile lands thus discouraged? The question is at once a national, political, and social one. It is far from being yet solved, but France in convoking this Congress in connection with her Exposition has taken the initiative for its solution.

There seems to be among all agriculturists a responsive movement in defense of agriculture from the dangers which threaten it, a movement that will inure to the benefit of all humanity.

When the present period of transition is passed, each country having profoundly studied the conditions of its agricultural production will form an exact idea of the measures to be taken to increase and defend it, and when by a series of scientific, financial, and economic reforms this has been done a general equilibrium will be established, and there will be employment enough for all the world over; there will be more work as there is more nourishment for the workers. The agricultural crisis has had its primary cause in the excess of production in certain regions, and will have for its effect the stimulating of other regions to increase their productions, in virtue of the economic axiom that much must be produced to be produced cheaply; hence the application of science and of scientific thought.

M. Déherain, secretary-general of the Congress, also spoke as follows:

A visit to the Quai d'Orsay suffices to show that agriculture is undergoing a transformation. Formerly in agricultural exhibitions products alone were shown, but now books, laboratory apparatus, statistical tables of the yields of experimental fields, are to be seen in such exhibits. Instead of being guided by tradition, cultivators, impelled by severe competition, are seeking to do better, and, so far from showing incredulity toward the teaching of science, are following its counsels. This salutary movement should be hastened and aided in every possible way, and it is the interest of the cultivator to judiciously employ, by the aid of science, natural forces in the production of increasing quantities of animal and vegetable matters to such an extent that humanity shall suffer less from want of food.

The Congress was carefully organized, and the names of many of the first scientists and agriculturists of France were to be found upon its roll. The subjects to be discussed were divided into six heads, the first of which concerned the most important of all—the crisis in agriculture. The other heads were: (2) Agricultural credit, institutions, etc; (3) agricultural instruction; (4) agronomic industries; (5) viticulture and sericiculture; (6) protection of birds, destruction of noxious animals, etc. Pamphlets containing papers, statistics, etc., upon each of these heads were issued, and questions upon each subject proposed to the action of the Congress, which, after full dis-

cussion, gave utterance to its *voeux* or resolutions by a vote of all its members.

Since the Exposition of 1878 European agriculture has been undergoing a severe crisis, which has profoundly modified the economic conditions of the cultivation of the soil, and has affected commerce and industry.

If we compare the production of wheat in France in the years 1875–'78 with that in 1885–'88, we find that there has been a diminution amounting to an annual loss of 275 millions of francs, while in the production of other grains (rye, barley, oats, maize, etc.) there has been an annual loss of 550 millions. During the same period the Phylloxera has been devastating the French vines so as to cause an annual loss calculated at 600 francs per hectare upon 500,000 hectares, or a total of 300 millions of francs. Annual products have also depreciated until there has been an annual loss of about 286 millions. All these items show that France has for the last ten years been undergoing a loss of revenue amounting at least to 1,200 millions of francs yearly, and this agricultural loss has naturally had its influence upon the commerce and the manufacturing interests of the country.

Not only does this state of affairs exist in France, but also in all western Europe. In England there has been 30 per cent diminution in the amount of wheat sown, and in 1888 this fact necessitated an importation of grain and flour into that country amounting to 1,200,000,000 of francs (£48,000,000), but as only 7 per cent of her population belongs to the farming class, and as half her soil is owned by only 7,400 landholders, England has not thought it worth while to modify her economic régime which gives such impetus to her commerce, manufactures, and colonies. Germany, on the contrary, is endeavoring by legislative means to do away with foreign products and to produce all she can upon her own soil, and even to distribute a surplus among neighboring markets; she has, however, not escaped the crisis, and each year a half million of her inhabitants, mostly of the agricultural class, emigrate across the ocean. In Belgium cereal culture has suffered serious loss. In Italy and Spain the consumption of cereals is less important than in France, but the vines in these two countries have been seriously attacked by Phylloxera.

The first consequence of the depreciation in the value of agricultural products was a depreciation in the value of land, especially in the north, east, and center of France, where cereals are largely cultivated; in the west and central plateau, where grazing and dairy interests hold a large place, the loss has not been so great. A few instances may be quoted:

Out of 89 communes in the arrondissement of Lunéville, two had increased their revenues from 1880–'88 to the amount of 7 per cent;

in five the revenue had remained stationary, while in 82 communes it had decreased. Eleven farms belonging to the hospitals at Nancy, and containing together 438 hectares, have depreciated in rent from 49 francs per hectare in 1880 to 25.70 francs in 1888.

In the Department of Seine-et-Oise the decrease of rents upon lease has been from 8 to 20 per cent. At Meaux there was a decrease of 22 per cent in 1885, which has since increased to 30 per cent; the culture of the sugar beet diminished from 37,000 hectares in 1878 to 27,000 in 1888, and the number of sugar mills fell from 90 to 50; the flax culture also decreased from 8,865 hectares to 3,388, that of colza from 5,530 to 860, while the price of a quintal of colza went down 25 per cent.

The culture of forage crops and of tobacco alone increased, the latter advancing from 648 to 1,413 hectares. In the Department of Lot-et-Garonne, at Claivac, the value of land depreciated 40 per cent, with a decrease of 15 per cent in wages at the same time and an increase of 16 per cent in taxes. In the Department of Vienne "the diminution of the value of produce has brought on a depreciation in the value of land, the abandoning of farms, a decrease in labor, and a corresponding increase in the vagabond mendicant class. Land has depreciated 30 per cent in value, and cattle also 30 per cent; while the depreciation of farms has been 25 per cent."

In the western Departments, Sarthe, Mayenne, Vendée, Deux-Sèvres, etc., grazing has been less affected, and the lessening in the value of farms has been principally caused by the fall in the price of meat for two years (1886–1888) and varies from 10 to 15 per cent.

In Puy-de-Dome land has gone down in price 25 per cent and wages 15 per cent, while the culture of cereals has notably decreased; the area of grazing lands has increased from 120,000 to 150,000 hectares, and that of vineyards from 30,000 to 40,000 hectares. In the nine Departments of the southwest there has been a loss per hectare upon—

	Francs.		Francs.
Wheat	38.18	Buckwheat	52.91
Meslin	9.57	Maize	54.61
Rye	17.85	Potatoes	150.25
Barley	17.18	Vine	74.25
Oats	45.22	Tobacco	69.81

Corresponding to an annual loss of revenue of 110,000,000 francs for the whole region, or a loss of 30 francs per inhabitant. The depreciation in value of live stock, which is 13,000,000, would bring this figure up to 33 francs per inhabitant.

Along the Mediterranean the rearing of silkworms is barely maintained, while madder has completely disappeared in competition with artificial alizarine.

The value of the olive trees has also decreased 60 per cent.

Wages have undergone like depreciation though in less proportion. Vintners, were paid 2 francs (40 cents) per day in 1810, and 4 francs in 1874; from 1876 to 1882 this fell to 2 francs again, increasing in 1888 to 3 and 4 francs on account of better vintage. Already the attention of the Chamber of Deputies has been called to the fact that, in the matter of taxes, agriculture pays out 25 per cent of its revenue, while city property pays only 17, commerce and manufacturing 13, and personal property 4 per cent only.

As far as cereals are concerned the causes of this depression are to be found in the bringing into the market of excellent lands in the United States, Canada, the Argentine Republic, Russia, and India, and later perhaps Africa, and in the enormous reduction in maritime freight, which permits of a sack of wheat being more cheaply carried across the ocean than from one part of France to another. All this has been greatly aided by emigration from Europe, which amounts to a million of souls yearly. These lands are easy of culture, and as yet do not need the aid of fertilizers and are unincumbered by too heavy taxes, besides which expenses are constantly being increased all over Europe by the great and deplorable armaments which governments feel obliged to keep up.

At the end of the present century the public debt of the United States will be almost paid off, while that of Europe is increasing.

Besides other expenses caused by European armed peace, one-eighth of her population is withdrawn from legitimate work and is rendered unproductive. It is probable that for a long time to come the United States will continue to be the granary of Europe. At present there are in the United States 15,000,000 hectares (or 37,000,000 acres) sown with wheat, and the harvest varies between 150,000,000 and 170,000,000 hectoliters, or over 4,000,000,000 bushels.

The consumption of wheat in the United States is 1.55 hectoliters per head, and the Anglo-Saxons consume much less bread than the French do. Even should this production of wheat remain stationary, it would be more than sufficient to nourish 80,000,000 of people, which is the probable population of the United States at the end of the nineteenth century and would leave a surplus of 30,000,000 hectoliters for exportation.

Custom duties are only a palliative and can not hinder the invasion of foreign goods or make them much dearer. In France cereals are admitted free, however, notwithstanding the protestations of cultivators.

There are various causes for the depreciation in the value of live stock. A diminution in the consumption of meat has been mentioned, but it can not be found that any such diminution exists. There has been, to be sure, a decrease in the amount of meats sent out from the abattoirs in Paris, but this has been largely compensated by importation of fresh meat from abroad. Account must

also be taken of the considerable increase among animals, especially those of the bovine race, also of their diminution in mortality, thanks to M. Pasteur's discoveries. The importation of French cattle into England must not be forgotten, nor the continental fall in price of hides, wool, lard, and other animal products.

Diminution of amount of oilseeds planted is due to the competition of American and Russian petroleum, while that in textiles is occasioned by the introduction of Russian flax and Italian hemp.

The vine has almost perished by Phylloxera; it is enough to say that one-half the French vineyards have gone, and yet French viticulture remains the most considerable in the world, and still produces the most highly esteemed wines. The reconstruction of 500,000 hectares of vineyards at 2,000 francs per hectare has cost a milliard exclusive of the loss of four or five years' harvests.

In the Department of Hérault 92,000 hectares have been replanted at a cost of nearly 200,000,000 francs. The vintage of this Department in 1888 was 4,507,000 hectoliters at 22 francs a hectoliter, or about 100,000,000 francs.

During the period in question many legislative measures have been taken with a view to relieve this crisis. These have served to prove the interest taken by the Government in agricultural needs but still are not fully satisfactory. The true remedy is to be found in an increase in the yield of all products. If a quintal per hectare more wheat can be produced in France, there will be no more need of foreign supplies; such a result is not impossible with energetic work, good distribution of crops, and an application of scientific discovery, also with the dissemination of agricultural instruction, the facilitating of credit and transmission of property, remitting parcels of land, forming of association and forming of societies.

But what agriculture most needs is to be treated on an equality with other industries in the matter of taxes and customs duties.

Much has already been done. Great improvements have been made both in animal and vegetable products, as may be seen at any cattle show or exhibition. The number of cattle has increased and their quality has been much improved by careful breeding and a system of selection.

Horses also have increased and improved, and former importers have now become exporters. Swine are sufficient for all demands, while as to poultry, France is without a rival; aviculture is a French industry, and its products are sent all over Europe. Only in sheep has there been a lessening of numbers every year.

The improvement in vegetable products is of recent date but has been greatly facilitated by the creation of an experimental laboratory at the Institut National Agronomique.

Experimental fields have been established all over France and many experiments have been tried with a view to improving the

potato and especially the sugar beet. With the latter excellent results have been obtained, the average sugar content having been increased from 8 to 14 per cent.

Agricultural societies and clubs have popularized new discoveries and have encouraged exhibitions, though not without difficulty at first. The creation of syndicates has also been of great and still increasing benefit.

The use of agricultural machinery has made enormous progress in the last twenty years, but in certain parts of France it has met with difficulties on account of the way in which the land has been divided into small parcels or lots. No industry has changed its tools so completely as has agriculture, and it is said that in the north and east of France none of the tools are now used by farmers which were used by the last generation. In 1882 the value of agricultural implements in France was 1,300 millions of francs; impulse is given to the purchase of instruments, by the encouragement by the syndicates of purchase in common at a low price (sometimes a reduction of 50 per cent is made). The use of fertilizers has also increased enormously; the small French cultivator was for a long time mistrustful of fertilizers, and was too often defrauded by dealers in them until the syndicates aided him by their councils and by enabling him to buy a guaranteed quality at wholesale price. It is the syndicates also which have continually fought against the too minute division of the soil, and who are also able to render great services in the matters of drainage and irrigation.

After a discussion of these matters the Congress made the following recommendations:

(1) They counseled a judicious choice of fertilizers and seeds, and recommended the establishment of fields for experiment and demonstration, believing that by such means yields would be increased and cost of production diminished.

(2) Also the maintaining of cereal culture in those regions only where it is found to be remunerative.

(3) Lessening by means of syndicates the cost of agricultural supplies, etc., caused by intermediary dealers.

(4) Protection of each agricultural product by a customs duty.

(5) Energetic prosecution of adulteration in alimentary supplies.

(6) Suppression of through rates (*tarifs de pénétration*).

(7) Diminution in conveyance fees (*droits de mutation*) so as to facilitate the transfer of property.

At the end of the session it was shown that the real estate owner is in an abnormal position as regards the owner of personal property. The former pays 15 or 20 per cent of his revenue in taxes each year, no matter what his harvest may have been, while the latter never pays more than 2 or 3 per cent, or, should he receive no dividends, he pays nothing. This state of things exists in many other

countries also. The Congress was therefore asked to express the opinion that taxes upon real estate should be diminished, which was done.

AGRICULTURAL CREDIT.

The question of credit in its relation to agriculture has of late years been the object of study to many persons and in all lands. Agricultural societies generally agree in attributing slow progress in agriculture to insufficient capital, and that this insufficiency is principally due to want of credit, and credit is wanting because the nature of agricultural industry and the laws of several countries do not permit the farmer to give such security as merchants or manufacturers may give.

In France, the situation of farmers as regards credit has long been the object of numerous complaints, and the Government has on several occasions occupied itself therewith. In 1845 studies were made, notably in Germany, to find means to afford such credit. In 1848 the minister of agriculture outlined a law to this end, and in 1856 a commission proposed the authorization of loans upon property, an innovation which was opposed by the Counseil d'État, though the Government created a society of agricultural credit as an annex to the Crédit Foncier. This institution did not answer its purpose, and in 1866 a new commission proposed: The suppression of certain articles in the code civil which restrained the liberty of agreements in the matter of leasing of cattle (*cheptel*), the establishment of loans upon property without surrender of that property; the *privilège sur la récolte* to be in favor of the dealer in fertilizers (*i. e.*, the wares to be bought directly from him in preference to dealing with middlemen); the extending of the jurisdiction of tribunals of commerce to notes indorsed by cultivators. This project was interrupted by the grand investigation of 1876, when it was decided that the Government should leave to private enterprise the task of creating institutions of agricultural credit, and that such institutions must not expect any modification of the common law, although no change in common law was to be excluded, provided that it benefited all classes and industries alike. No solution of the problem was yet reached and nothing was done till 1879, when another commission was appointed, the conclusions of which were as follows: Neither the State nor any Department nor commune should meddle directly with credit operations for any single industry; the State should grant no aid, even such as supervision, etc., to any establishment of credit founded in the interests of agriculture; various modifications in legislation were desirable. This report was followed in 1882 by the depositing with the Senate of a project for a law having for its objects: Security without surrender of property pledged; reduction of the privileges of rural money-lenders; the conferring of indemnities

due on account of insurance; the negotiability of checks payable to order. Soon after this it was proposed to organize agricultural banks under Government surveillance.

These various projects have not yet been discussed by the Chamber of Deputies. In 1883 counsel was taken by the minister of agriculture with the Société Nationale de l'Agriculture, the society calling together all its members and asking the opinion of its foreign correspondents, with the result that, although the advantages of credit for farmers were contested by a few, its necessity in regions of important culture and in grazing regions was proclaimed by the greater number of authorities and these of the best. An inquiry made abroad confirmed the desire shown in most countries to establish such credit. Finally, in December, 1887, a report was made adopting the following clauses: Restrictions of the privileges of the lessor or money-lender; the conferring of indemnities due on account of insurance; the negotiability of checks payable to order. This last clause was rejected by the Senate, but the other two were adopted November, 1888, and promulgated in February, 1889.

At different times legislators have been solicited to give facility to credit by creating special privileges for certain real estate or personal property. The chief privileges have been, first, that to the dealer in fertilizers to whom it was proposed to give the same rights as given to seed-dealers—*i. e.*, sums due for seeds are to be paid on the basis of the price of the harvest; and, second, that resulting from security, without surrender of property pledged, viz: It is a general principle of French law that when a loan is made a pledge or security must be given up to the creditor by the borrower, and that without such surrender there is no transaction. Now, the farmer rarely possesses any property beyond his agricultural implements, animals, crops, etc., which by their very nature can not be disposed of without great inconvenience to his farm, so that he is often unable to give any security at all. Precedents, however, have already been found in support of a reform in this direction. In what concerns the negotiability of checks payable to order, the French law allows such checks from farmers to be negotiated provided they bear the signature of any merchant. This custom has for several years been in practice in the Department of the Nièvre with good results.

There is in the arrondissement of Seulis an agricultural syndicate which is not only a coöperative society for the purchase of fertilizers or instruments, but is also a veritable association for mutual credit, analogous to the popular banks of Italy.

It would appear from the following data concerning the establishment of agricultural credit in various countries, that those places where the farmers seem to suffer least from want of credit are not those where they are regulated by special laws or where they enjoy

peculiar privileges, but those where the farmers, like all the other inhabitants, are submitted to common law.

England and Scotland are the countries where the farmers most easily find credit. English and Scotch banks have branches at all the agricultural centers, and cultivators enjoy the same privileges as merchants or manufacturers for raising money upon credit or upon personal effects.

In Germany there exist in most districts a great many mutual credit societies organized upon the Schultze-Delitzsch system (*i. e.*, depending upon unlimited joint responsibility). In Westphalia and the Rhine provinces the so-called Raiffeisen banks have been founded for securing credit for small farmers.

In Austria-Hungary agricultural credit mobilier may be said not to exist at all, though in Galicia a privileged establishment of rural credit has been created. Many small Schulze-Delitzsch associations have been formed, but these are in towns and have no connection with agriculture. Divers projects have been proposed, including loan without surrender of property pledged, the restriction of the privilege of the landholder and the negotiability of bills of farmers. Contrary to the opinion of partisans of these reforms, it is the opinion of certain persons at Vienna that on account of the inexperience and improvidence of small farmers their assimilation with tradespeople will lead to their ruin.

In Belgium the negotiability of agricultural obligations was authorized by a law passed in December, 1872, and again by one in March, 1876. A law passed April 15, 1884, allows the savings banks to make advances to farmers by the intervention and guaranty of local houses, which advances may be effected in the form of discounts and accounts current without need of mortgage; the guaranties given by the local houses (*comptoirs*) are reimbursed by *del credere*s (additional premiums or commissions).

The same law restricts the privilege of the landowner and allows the constituting of a privilege of the farmer (cattle, tools, harvest, etc.). This law has not as yet attained the end which its enaction aimed at, which was to bring credit at a reasonable rate within the reach of the farmer.

In January, 1887, there were but three such banks, and the number of agricultural loans was but seventy-five, while the sums loaned did not exceed 660,000 francs, although the cost of these loans was only 4 per cent. The superior council of agriculture, being questioned by the Government as to the situation and its remedies, claimed the following modifications: Reduction of the rate of interest; creation of credit unions or popular banks. These modifications were judged impossible, both by representatives of the Government and the savings banks.

In Spain special institutions called *positors* render some service to

small farmers, but are institutions of charity rather than of credit.

In Italy legislators have sought to satisfy the needs of credit by certain laws. That of June, 1869, authorized the forming of societies and institutions of agricultural credit enjoying certain privileges, among which was the right of issuing special agrarian credit vouchers payable to the bearer on sight. Banks founded in accordance with this law have not developed, and in June, 1883, these agrarian vouchers only amounted to three and a half millions in Italy and to ten millions in Sardinia. This law was therefore abrogated and the agricultural capital of proprietors and farmers (such as livestock, investments, harvest, etc.) taken as a guaranty for loans accorded by agricultural credit societies; and also were instituted: reduction of the privilege of the landholder and conveyance of indemnities due for insurance; government limitation of maximum rate of interest; regulation of loans on mortgage granted for improvements in cultivation, etc.; reduction in registration fees. It is not known whether this law has worked more successfully than that of 1889, but it is a fact that Italian farmers find easy sources of credit in the popular banks which abound in that country.

In Portugal a privileged society for the organization of credit on mortgage had long been in operation, when in 1867 a law was promulgated for facilitating the creation of establishments of agricultural credit. This law requires that the capital shall be constituted from funds of charitable institutions and subscriptions for shares. Minute regulations have been made, among which is one allowing a borrower to retain his pledge. Since 1868 a single bank has been constituted in conformity to the law, and has not yet received much extension, so that the experiment is as yet incomplete.

In Roumania a law, now about ten years old, directs that there shall be established at the chief town of each district a bank for agricultural credit; the capital of such banks is advanced by the State until it is made up by shareholders, and the bank makes discounts, loans upon pledge, loans on shares, and receives deposits; loans are made upon checks to order, guaranteed by two solvent farmers. Security without surrender of pledged property is allowed for harvests, cattle, or any agricultural capital. This law has already rendered great service.

In Switzerland there is no special legislation in favor of agricultural credit mobilier, but the subject has been considered by most of the agricultural societies. Local banks are numerous in this country, their rate of interest being from 4½ to 5 per cent.

The following were the resolutions passed by the Congress in connection with this subject: (1) The credit now enjoyed by agriculture is not sufficient for the cultivation and improvement of the soil. (2) Such facilities as are now given to farmers for obtaining credit are not prejudicial. (3) It is desirable that legislative means

be employed to facilitate means and conditions for credit for farmers. (4) The Government ought not to intervene by according concurrence to certain establishments for credit founded in the interest of agriculture. It should limit itself to simple supervision and should leave to private enterprise the task of creating credit institutions operating without derogation of the common law. (5) In case that new legislative measures are deemed necessary the modifications introduced should be of a character especially adapted to agricultural industry; *i. e.*, there would be need of (*a*) establishing freedom of agreement in the matter of cattle-leasing (cheptel); (*b*) authorizing, in a general way, mortgage without surrender of property; (*c*) authorizing a privilege in favor of the lender upon the harvest or agricultural instruments, without prejudice to the owner thereof; (*d*) creating a privilege upon the harvest in favor of the dealer in fertilizers; (*e*) permitting the negotiability of certain liabilities of farmers.

(2) *Rural Assistance.*—I can give no better idea of this subject than by quoting in substance the report made by the president of this section, M. Gomot, before the Congress, who spoke as follows:

Do credit and provident institutions in the rural districts really aid the farmer during hard times? Are there any "old men's homes" for the farmer? Does the country laborer sufficiently understand the advantages of such institutions? Do such societies work for his advantage? What improvements are brought to his lot?

No; enough has not been done in the interest of small proprietors and their laborers, though measures have been taken and are now awaiting legislative sanction.

Merchants and manufacturers have advisory chambers to uphold their claims, but the farmer has none; no matter how small their business these former have means for obtaining credit, and they are able to mobilize their fortune or to negotiate its value at small cost, while the farmer has no other resource than to borrow upon mortgage and has to pay 8 per cent. Merchants and manufacturers have superannuation funds, mutual-aid societies, retreats, etc., while the farmer is far from enjoying these advantages; if he is ill he often lacks medical attendance, and when he is infirm he is not always sure of an asylum.

All over Europe there is a tendency to abandon country life for life in the large town, and it is estimated that in the last ten years one-fifth of the whole rural district has thus emigrated. How explain such a movement among a people so agricultural as the French? Many reasons have been given, but the most serious of these come from the conditions of existence so different between city and country people. Facility of communication, education, newspapers, have awakened the intelligence of the people and allowed them to draw comparisons for themselves, and to decide wherein lies their fortune or their misfortune; as soon as the countryman has decided this point his sole ambition is to live in the town and assure there a better position for his children.

Every one talks nowadays of restoring our impoverished agriculture and bringing value back to our abandoned fields; but for this we must have men, and we can not repopulate the soil until we can make the peasant love the soil, and he will not live upon it until he finds real advantages there, that means to support his family in his old age.

Public assistance as now constituted exists only by exception in the village, and in most of our rural communes there are neither charity bureaus nor hospitals,

nor houses of refuge, savings banks, aid societies, economy bake-houses, nor anything which may ease life or defend the laborer from distress. Generous attempts, however, have not been wanting.

The French constitution of 1791 proclaimed the *right to assistance* of all the infirm, unfortunate, or sick. A decree of October, 1793, virtually established the responsibility of the State and that of the communes ; the latter were obliged to provide support for the infirm and organize relief for the aged and work for the indigent. Unfortunately, however, resources were wanting and the law was never enforced,

In 1848 new efforts were made, bringing about some few results, among which may be mentioned the excellent laws upon judiciary assistance, almshouses, unhealthy lodgings, etc.; the benefits of legislation concerning foundlings and concerning the insane, both of which classes receive efficient protection, are noticeable.

It is for the third Republic to complete and extend this fragmentary legislation.

Besides the usual aid among members of a family and private-enterprise charities there is public assistance, conducted by the commune, Department, or State. The commune or village has a duty to perform towards its needy inhabitants which is also of social interest, for when sickness or misery drives the individual towards the city the first step is taken towards mendicity or vagabondage.

Enforced idleness (*chomage*) is the principle of all misery and often results from illness or from a state of things impossible of prevention ; certain communes might remedy this by organization of labor, and all might alleviate it by creating charity bureaux or medical relief. In theory a charity bureau is necessary for each commune, a state of things actually realized in Belgium ; unfortunately France has too often yielded to the desire shown by even the smallest village to be erected into communes, and there are now many such agglomerations containing less than 1,000 inhabitants each. For such might be created a single charity bureau by a syndicate or reunion of several. When the sick farmer knows that nourishment is assured him during his illness and that care and remedies will not be wanting there will be an appreciable amelioration in the condition of the rural classes; those thus aided must be under rigorous control so that assistance given shall not be an excuse for idleness. In cases of serious illness, or for incurable patients or for the aged, it has proposed to establish a refuge-hospital in each *chef-lieu de canton* or principal town; many cantons can not afford such hospitals, but are able to gain admission for their sick to the hospitals of neighboring towns, which always have spare beds and attendance.

As to provident institutions there are, in the first place, the savings banks ; these have rendered great service in the country as well as in cities, and the government has neglected nothing in order to encourage them, and, thanks to postal-savings banks, there is now not a commune in France that does not benefit by them. The peasant hesitates to part with his capital and so does not buy shares in stocks, but he willingly places his money in a savings bank, and this is his only method of laying up money ; he is utterly ignorant of life insurance, but accepts more willingly societies of mutual aid. Still, in some departments an advance has been made, especially through the agricultural syndicates, and it is not to be despaired of that our farmers will soon accept the grand laws of joint responsibility (solidarité) which govern modern society.

In connection with the above report the following resolutions were passed by the Congress : (1) In default of family the communes should give aid to the sick, infirm, and aged ; several communes might unite for such purposes, joining a syndicate, and might be authorized to use their resources to such an end. (2) It would be expedient to establish a bureau of assistance in each commune or

syndicate of communes in order to assure aid at homes or in hospitals. (3) Each Department should organise a general system of public assistance, establishing a budget therefor and determining rules for service. (4) The resources of such a budget should have triple origin ; a contingent from each commune in proportion to its resources and the number aided, a departmental subsidy and a subsidy from the State. (5) It is the duty of the State to facilitate by all means societies of mutual relief and pension banks (caisses de retraite) for rural laborers.

(3) *Parceling of the Soil.*—To an American traveling upon certain French railways the appearance of the fields is peculiar ; at first these appear to be of vast extent, but it is soon observed that they are in reality composed of a number of smaller fields and that the almost total absence of fences or hedges, even along the highways, causes their peculiar appearance. Generally these individual fields are of moderate size, but often they are seen to be very small, only a few square yards in extent, or perhaps a ribbon of land two or three yards in width by some twenty or thirty in length ; these patches of land are nearly always rectangular. Laid out with mathematical precision, the rows of cultivation seem to have been drawn with a ruler, and there is hardly anything to distinguish the division of one patch from another, except the difference of the crop, and it might be supposed that the whole of one great extent was cultivated by one proprietor did we not know to the contrary.

This question of parceling of the soil has become one of considerable importance within the last few years. The term parceling (*morcellement*) has two different interpretations: first, land may be divided, *i. e.*, it may be occupied by a large number of proprietors, the size of each field being less as these are more numerous; or it may be dispersed, *i. e.*, several small and disjointed parcels of land may belong to one proprietor, and may be separated from each other by the lands of other proprietors. In a certain way this division, if not too great, may be of benefit, since a large and unproductive lot of land may, by division and cultivation by several tenants, be made productive, and it is true that the more landed proprietors there are in a community the more good citizens there are predisposed to law and order. It is difficult to apply a fixed rule, since the best solution depends upon manifold circumstances, as locality, character of inhabitants, modes of culture, in what lands the capital devoted to agriculture is, etc., though a partial solution seems to have been reached in the German *Hof* or domain of moderate size, to guarantee the integrity of which several laws have been made since 1874. The *Hof* may be left integrally by the will of a father to any of his sons, or in default of a will, it goes to the eldest, the heir who receives it paying a certain indemnity (*soulte*) to the other heirs. This custom is found in Hanover and Westphalia, and has

been adopted by Austria, and seems to have given excellent results, the agricultural crisis in these countries having lost its intensity.

Such a custom might succeed well in Austria, where property is organized upon a basis of feudal origin, but would never succeed in France, where all children inherit equally from the parent.

It has been demanded that this law should be abrogated upon the plea that the rights of succession granted to heirs to the French code civil abnormally develop the individualism of each to the detriment of all idea of family union; and so far as agriculture is concerned it is shown that the right of each heir to claim his share in real estate as well as in personal property has brought about an infinite parceling of property. The remedy proposed for this is to recognize the absolute right of the father of the family to dispose of his property by will, and the Congress considered the question whether the interest of agriculture demands any such modification of the laws of the succession.

Although the division among heirs is one of the chief causes of the parceling of the soil, there are other causes, among which is voluntary division; large domains are sold piecemeal, a system which no doubt brings profit to the seller and often also to the buyer, who can thus invest small amounts of capital. Some writers have held that this custom is a source of future danger, but such danger is a chimerical one, and proprietors need not yet be restrained from retailing their land.

The question of the disposition of property and its consequent danger is to be looked at in a totally different light.

Everyone can see the superiority of a farm cultivated compactly under one tenant over another farm consisting of several parcels of land far apart from each other; in the one supervision and improvement are easy and time need not be lost, while in the other important operations upon isolated fragments of land become almost impracticable, and incurring the necessity for neighboring parcels, all to contain the same crop to avoid complication. Unfortunately, in many regions there are many numbers of such small patches of land irregular in outline, dovetailed into each other, and far from roads, sometimes much time is lost in even reaching them, and complications arise regarding right of way, etc.

Opinions are diverse as to the remedy to be applied for this state of things; it is thought by some that those interested (*i. e.*, the cultivators) should alone take the initiative and should leave to the land owners full latitude to sell, buy, or exchange their parcels, while others are of the opinion that legislative measures are necessary, and maintain that if left to himself the farmer will never take measures energetic enough to accomplish the desired result, and they quote the example of Germany, where good results have been obtained from united action, results which must have been long

known, for at the end of the sixteenth century we find Switzerland attempting to remedy the too great parceling of her soil by a redistribution of land. Numerous similar operations are to be found during the eighteenth century, particularly in England and Bavaria, while since the French revolution this practice has been followed with success in Germany; in several states (Baden, Saxony, etc.), important laws regulate such distributions. Generally a vote of the majority of the inhabitants is required, the lands are appraised, competent persons draw up the new plan of distribution, including roads, etc., and finally a pro rata distribution is made among the land holders; thus in the commune of Hochhaida, in 1865, the number of separate fields was reduced from 774 to 35 almost every one bordering upon a road, the consequence being a considerable increase in the harvest.

Notwithstanding its excellent results, this system is not without serious objections; in the first place, it is only applicable to territories, rare in France, where the parceling has acquired extraordinary development, and, secondly, it is claimed that such forced exchanges are equivalent to veritable dispossessions, and are in manifest violations of the right of property, besides which it would be dangerous to introduce a system which would deeply wound the sentiment of attachment to the soil so strong among the French peasantry.

Certain economists have held that it was possible to arrive at the desired result by inducing voluntary exchange among proprietors by giving them every facility to that end, and in view of this a law was promulgated in 1824 reducing the tax upon exchange of rural property; this law was, however, annulled in great measure ten years later, but restored in principle in 1884 by a law which makes a considerable reduction in the tax upon such exchange.

It is difficult to say whether this will give good results, as it is claimed that the chance for reuniting scattered parcels of land by direct exchange rarely presents itself, and that there is generally a bonus (*soulte*) to be paid by one side or the other.

Several suggestions have been offered in solution; laws facilitating transfer of property might be passed which were not limited to direct exchange. Syndicates among landholders might be found with a view to promoting mutual exchange or to providing better boundary marks.

Again, it may be determined what are the evils of too great parceling, and these may be remedied by special means, for instance, as parceling produces dovetailing (enclaves) of fields and consequent quarrels concerning right of way, let roads and paths be built, the very making of which may bring about direct exchanges; or let syndicates for drainage or irrigation or other works of public interest be formed. If it be objected that in a territory too divided the small patches of land are difficult of cultivation, let such patches

be cultivated in common, the benefits therefrom being shared in proportion. This last plan has been tried in some countries with good results. Thus it is seen that on every side the remedy for agricultural evils is to be found in association.

The law of May, 1865, upon which the creation of syndicates is based may have imperfections, but these are easy of remedy. Its principle is the obligation for the minority to participate in the syndicate when a common evil is to be overcome (*e. g.*, the Phylloxera), but freedom for all if there is profit to be made or a single improvement to be instituted.

The following resolutions were passed: (1) Division of soil should not be considered as an obstacle to good cultivation, though extreme parceling is an obstacle. (2) In a case where parceling is to be combated it would be well to modify the French law of division of inheritance, and to examine in connection foreign laws and their results; and to allow the courts to compensate lots of real estate with lots of personal property, all from the same inheritance. (3) The reduction of conveyance fees in matter of exchange of rural property will facilitate the free reuniting of parcels of land. (4) The dangers or inconveniences presented by obligatory redistribution are of such a nature that recourse to such procedure should be avoided, notwithstanding the good results which it seems to have given in certain countries. (5) The law upon Sundic associations should be completed so as to apply to the reuniting of parcels of land.

The Congress strenuously opposed any reuniting or redistribution contrary to the wishes of the minority of those concerned. Expropriation might be practiced in the case of great works of public interest, as, for instance, a railway or a canal, but redistributions would in France be held as direct violations of the right of property, and would never become customary there, however they might be regarded in Germany.

The celebrated lawyer, Domat, was of the opinion that should a tenant materially increase the value of his farm by making improvements not required in his lease, as for instance by planting a vineyard or an orchard, he should, at the expiration of his lease, be entitled to compensation for expenses incurred by him, allowance being made for the fruits of such improvements already enjoyed by him. This idea has but partially found its way into the Civil Code, so that if at the expiration of lease a proprietor wishes to keep such improvements he may reimburse the tenant for expenses incurred but without regard to increase in value of the farm. In 1848 a law was proposed by Pégerat based upon the idea of a triple association between capital (represented by the soil) intelligent direction (represented by agriculturist) and manual labor (represented by farm laborer) each member of which should have an equal third of the profits. This proposition was rejected but was brought up subsequently with modifications.

In 1870 the proposition of M. Gagnier was to the effect that the farmer should be given two-thirds of the increased values but only of those of a permanent nature, such as acquired facility, marling, drainage, ditches and roads, plantations of trees, or buildings erected; of these only the first three are of an agricultural nature. The proposition, however, never underwent deliberation.

In March, 1887, a law was proposed to the Chamber of Deputies which was in substance the idea of Domat as above related.

In March, 1888, another proposition was made for a law governing the relations between landlord and tenant in short farm leases, in case of increase of value, both with a view to public interest and equity. According to the existing law, the farmer, should he deteriorate the land by poor culture, is obliged to make reparation for the same, but should the landlord profit by the culture carried on by the farmer he is not obliged to give the farmer any compensation whatever, which latter circumstance a new law should rectify. By this proposition such indemnity was only to be allowed upon leases running for less than eighteen years, and was not to be allowed unless an increase in rent were made during at least six years. One or two other propositions for similar laws have since been made and taken into consideration.

Analogous laws of other countries were cited before the congress; prominent among which was the English agricultural "Holiday act," dated August 13, 1875. In substance this act allowed compensation for certain improvements which might have been made upon the farm, and which were classed under three heads: In the first class it was supposed that twenty years would be necessary for the farmer to make up without aid the expenses occasioned him by draining his farm, erecting buildings, or planting orchards; in the second class marling was supposed to be similarly paid up in seven years, and in the third class artificial fertilizing in three years; therefore, in each case where he had not held his farm for twenty, seven, or three years since making such improvements he was allowed compensation for the remaining years. Provision was also made for the appraisal of such improvements by experts. This act was superseded by that of August 25, 1883, which retains the above division into classes but with some slight modifications, *i. e.*, all important improvements which might influence the composition of the soil are placed in the first class, drainage alone in the second class, and the use of fertilizers in the third. In the first class the consent of the landowner is necessary, in the second this consent might be dispensed with upon condition of certain formalities, and in the third it might be dispensed with altogether. The farmer has no right to renounce his compensation. An analogous law was made at the same time for Scotland.

In Belgium this question has recently been brought before the Parliament. A somewhat original solution was offered by the idea

that the true criterion of the increased value of a farm was the rate of interest demanded for it; for instance, if when a farmer gives up his farm, his successor is willing to pay 10 francs more rent for it than was formerly paid, this proves that the farm has been increased in value under the former tenant by at least this amount, and consequently the former tenant should receive from his successor a proportion of the rent for a specified time as his remuneration.

This question has been discussed by various agricultural societies in France since 1873, and the utility of such a measure generally recognized, though it has been felt that a general law would hardly be applicable to all sections of France alike. On the other hand it has been urged that such a law would cause immense depreciation of property and entail many lawsuits, and in other ways the question finds many opponents. Many resolutions, alterations, and suggestions have been offered, among which is the following: It is necessary to extend the term of lease and to introduce therein clauses providing for possible improvements with a calculation of proportionate compensation for increased value of the soil. Such improvements were enumerated as follows: (1) Creation of permanent pasture and mowing lands. (2) Irrigated meadow lands or works of irrigation. (3) Creation of or improvement in bridges and highways. (4) Establishment of water courses, wells, or reservoirs, or of works for application of hydraulic force, or water supplies for agricultural or domestic use. (5) Planting of osier grounds, vineyards, or fruit orchards, except as ornamental gardens. (6) Cultivation of waste lands. (7) Drainage. (8) Deepening of the soil by means of excavations or deep culture. (9) Loaming, marling, liming, etc. (10) Use of commercial fertilizers, except nitrates and sulphates. (11) Manures, etc.

The questions proposed to the Congress were as follows: (1) Is it expedient that to the farmer should be given the right of compensation upon expiration of his lease for improvements made by him if they have actually increased the value of the land? (2) If decided upon, should such right bear reference to improvements exclusively of an agricultural nature, and should such improvements be defined as in the English law? (3) Under what circumstances should compensation be allowed the farmer, and how should this be estimated—whether by an expert? (4) Should a contract be made in advance having useful expenditures as a basis? (5) Should increase of value be divided between landlord and tenant, and if so, what would be a legitimate foundation for such division?

After discussion the Congress voted their opinion that when a contract of lease is silent upon such a point, the farmer should, by a law yet to be created, be compensated for increase in value of the land brought about by his own improvements. At the same time the Congress did not give any specific definition of such

improvement, beyond that they should be exclusively of a cultural nature.

AGRICULTURAL INSTRUCTION.

An account of the system of agricultural instruction in France, together with a description of the various schools, their organization and courses of study, and with notices upon the various experiment stations connected with the schools, was contained in the preliminary reports of this section of the Congress, and will be found in detail in my report on class 73 *ter*. (Chapter III.)

Agricultural instruction in France is at present in a flourishing condition, and its schools are magnificantly organized, and yet several points were brought to the notice of the Congress, showing how desirable improvements might be made. After due discussion these points took the form of resolutions, as follows:

(1) The instruction given in the practical agricultural schools coincides with that given in the primary, superior, or elementary schools of the same grade, except that in the former certain agronomic subjects (natural history, general agriculture, rural engineering, etc.) are taught in addition, thereby making this instruction so much the more complete. And yet the agricultural pupils do not enjoy the same facility for promotion to higher instruction, such as is given at the normal schools, as do those who have not taken these additional agronomic courses, which is manifestly unjust. A resolution was therefore passed, assimilating the natures of the certificates of these two classes of schools so as to give them equal privileges.

(2) It was resolved that the programmes of primary instruction should be so modified as to bring about a preponderance of agricultural instruction in rural schools and of industrial instruction in city schools without, however, causing any great line of demarcation.

(3) Parish schoolmasters (*instituteurs primaires*) should be examined in matters appertaining to agriculture not by ordinary, but by agricultural inspectors.

(4) In support of a similar resolution adopted by the section upon agricultural industries this section of the Congress resolved that schools of sugar-making and of distillation ought to be established in France, no such schools being at present in existence.

(5) It was deemed advisable that investigations should be made with a view to promptly establishing a standard method of analysis for determining the composition of wines and for detecting adulterations therein.

(6) Except for the want of schools for sugar-making and for distillation it may be said that the organization of agricultural instruction in France is almost complete, and little seems to be wanting other than a multiplication of establishments or the exten-

sion of those now existing. A resolve was therefore made that the public authorities be requested to furnish means for developing the compass of agricultural, veterinary, and forestry educational institutions and establishments for agronomic research.

(7) A resolution was proposed that agronomic professorships should be created among the faculties of science, notably at the Sorbonne. Such courses of study would be the highest in agriculture and would complete the course of the Agronomic Institute. There are at present courses of lectures which are attended by one or two pupils only whereas agriculture, which is of interest to many, is not represented at the Sorbonne or at similar high institutions. After some discussion this resolution was adopted.

(8) An important resolution was that nomadic instruction in agricultural subjects, especially in apiculture, should receive greater development. Such nomadic instruction is a prompt and efficacious means of introducing better knowledge into the rural districts, and has been practiced in Switzerland for twenty years, being subsidized by the Swiss Government. Apicultural instruction is especially benefited by this mode of treatment, and has so improved bee-keeping as to make it an extremely important industry in that country.

Nomadic instruction already exists to a certain extent in France, but might be greatly increased.

(9) The last resolution was to the effect that stations for research should be completed at all the forestry schools, and that experiments in tree culture should be instituted thereat. Instruction at the schools should have for its object the study of the structure, vegetation, and culture of forest trees. It would also be advisable not to change the posts of forestry agents too often, so that they might have better opportunities to become acquainted with their respective regions.

THE SUGAR INDUSTRY. CULTIVATION OF THE SUGAR BEET.

The consumption of sugar in the whole world has more than doubled in the past twenty-five years, and now reaches the amount of 5,000,000 tonnes* annually, and will double again in twenty years: Europe uses three-fifths of this amount, or 3,000,000 tonnes, and the consumption varies in different lands, being annually about 3½ kilograms per person in Italy and Spain, 4 kilograms in Russia, 6 in Austria, 10 in Germany, 11 in France, 25 in the United States, and 34 in England. The two latter countries, which consume the most sugar, are just those which produce the least, and this brings about exportation from the producing countries, while it is probable that in some of the countries which now consume least this consumption will in-

*A French tonne = 1,000 kilograms = 2204.62 lbs. av.

crease rapidly and cause a new and important development in general production.

The sugar beet and the sugar cane are our principal sources of sugar; sorghum is as yet unsuccessful. The culture of the cane is only possible in hot countries and climates, while the beet may be grown in any of the temperate regions of Europe. In the United States and other American countries attempts at raising the sugar beet have not hitherto met with much success.

The extraction of sugar from the cane and the beet have given rise to two great rival industries, and in this rivalry the industry of the beet has achieved a brilliant success, for while it barely existed fifty years ago its product is now sufficient to supply half the yearly consumption of the world. The annual production of sugar from the cane is about 2,600,000 tonnes, while that from the beet is 2,400,000 tonnes, and either alone is inferior to the consumption of Europe. The production from the beet was only 1,256,000 fifteen years ago.

This great increase in manufacture has produced a corresponding development in agricultural prosperity and has given impulse to the study of the best rules of rational culture, *i. e.*, to the methods of rotation to be followed, and in this way the yield of cereals has been improved. Besides, the sugar is extracted during the winter months when no cultivation is going on, and has so given rise to profitable occupation for many. The process of manufacture leaves many nutritive properties in the pulp which is utilized as fodder for cattle, while other by-products may be utilized as fertilizing material.

In beet-growing countries special laws have been passed in order to favor the development of this industry so that it shall not only satisfy home consumption but also leave an excess for exportation. There is not only a rivalry between cane and beet sugar makers but also one as regards exportation among the beet-sugar makers of the different countries of Europe; the industry develops not only in proportion to the richness of the soil and the industrial resources of any country, but also in accordance with any special advantages afforded it by fiscal laws. Thus France, which fifteen years ago occupied the first place in this industry, now holds the fourth, since she took no part in the great development in beet-sugar making which has since been going on; her production at first remained stationary, and was then soon threatened with ruin on account of the great development achieved in neighboring countries under the application of beneficial fiscal laws. In 1874 there were 539 factories in France, while in 1884 there were only 449, and during the same period the production of beet sugar in France declined from 450,000 to 316,000 tonnes, while in Germany it rose from 256,000 to 1,154,000, and in Austria from 222,000 to 557,000 tonnes. It was to remedy this decline that the statute of 1884 was passed.

This law counsels that sugar-beet roots should not be sold by

weight alone, but that their richness in sugar should also be taken into account in fixing the price, and this has been the point of departure for important improvements in cultivation since that time. New impetus was thus given, and experiment fields were established where the preparation of the soil, the choice of seed, the time of sowing, the distance at which the plants should be set from each other, the application of fertilizers, were all studied as to their effect upon the amount of sugar contained in the root, and the result of these experiments has been that beets have been obtained increasing in quality from year to year, as the following table will show:

	Mean of two years.	
	1882-'83.	1887-'88.
Juice in 100 kilograms beet root	95.	95
Densimetric degree of juice ... degrees	5.2	7.0
Sugar per degree	2.08	2.25
Sugar per 100 liters juice	10.81	15.75
Sugar 100 kilograms root	9.76	13.98
Impurities per 100 kilograms sugar	28.2	18.4
Weight of roots per hectare	375.00	275.00
Weight of sugar per hectare	36.60	38.84

It will be seen that although the actual weight of roots per hectare is less, the total amount of sugar is greater, and consequently the value of the harvest has increased.

In fact, since 1884 this industry has made notable progress, which might even be improved upon; roots of great richness and purity and even of increased weight might be produced, and it would be of great assistance to cultivators if all data could be collected from the experimental fields and put into such shape that special and appropriate directions could be made as to planting, etc., in each region.

Previous to 1884 the juice was extracted by means of presses more or less perfected, but which entailed a loss of sugar, sometimes amounting to 17 per cent. Since that time the diffusion method of extracting the juice has been generally adopted, especially as it obviates about 90 per cent of the above loss, and thus effects a saving in the whole country of about 75,000 tonnes of sugar yearly.

There have been no especial improvements in methods for extracting the sugar from the juice, and much is left to be desired in this direction. The total loss in sugar before the introduction of the diffusion process was 40 per cent, while it is now 20 per cent, which is still an enormous figure. About 14 per cent of the total sugar is contained with the impurities in the molasses, and is used in distilling instead of being recovered, and as this loss amounts to nearly 80,000 tonnes of sugar yearly, many processes have been devised for its recovery, but these are very costly, and a really cheap and efficacious method is still wanting.

Thus, although much progress has been made, much remains to be accomplished. Manufacturers have organized very complete

laboratories and have intrusted their manufacture to educated scientists recruited from the special schools of the State, but although the education of these scientists has been of the highest order it is not sufficiently specialized or fitted to the work in hand. The same remark, by the way, might be made in reference to the distilling industry, which has many points in common with sugar refining, and it is not at all doubtful that a special school of instruction in these two branches of technology would be of lasting service.

Upon July 10 this section of the Congress visited the seed-growing establishment of MM. Vilmorin-Andrieux et Cie., at Verrières-le-Buisson (Seine-et-Oise), about 14 kilometers south of Paris. This establishment was interesting not only as being an important seed-producing plantation, but also as constituting in itself a private agronomic station of special organization for the study of the multiplicity of questions concerning seeds which arise annually. The industrial production of seeds should, in order to be as perfect and as economic as possible, be decentralized; each variety should be cultivated upon the soil and under the climate best suited to it, and such a plan has always been followed by this house. Known and proved cultivators are employed by contract, and only use such seeds as will succeed best in the various regions, these seeds being furnished by the house itself. These cultivators are carefully watched, and their products are rigorously examined and rejected unless they conform to certain standards. In this way M. de Vilmorin has cultivating agents all over France and even in some of the neighboring States. The station at Verrières then serves the double purpose of producing the finest varieties of seed for such agents, and of inspecting and controlling the productions of the agents by a rigorous experimental culture. Growing collections to be used as standards are cultivated each year, and there is not in any of the Government establishments such a collection of them as may be seen at this private station.

The visit to the experiment fields was of great interest. At first there was seen a vast wheat field, where fifteen or twenty varieties were growing side by side, separated by wide paths. These wheats are intended to renew yearly the seed used by landowners or farmers who furnish wheat for sale. All these lots of wheat were absolutely pure, and the difference in precocity, apparent yield, height, appearance, etc., between various varieties could be easily seen. The Roseau, Australian Poulard, Dattel, and Goldendrop wheats were those appearing to the best advantage.

Next came a field of forage beets, where 400 to 500 lots of the seed of 1888 were under comparative cultivation. In general these lots were very uniform, and we were told that the total weight of all the beets in this field was not far from 1,000,000 kilos.

There were also two fields of sugar beets, in deep, light soil. These

were in excellent condition, as the year 1889 was not one in which the white grub was prevalent. A custom is observed of setting aside separately the seed of each particularly choice single root, this seed being tried separately and excluded from reproduction if it does not upon the first trial yield what is expected of it. In fact, it has been observed that excellent roots may not unfrequently have inferior progeny. All these sugar beets appeared to be of extreme vigor, and all varieties were represented, including German varieties, for comparison with native.

Fields of vegetables, such as beans, peas, cabbages, squashes, etc., also fields of flowers, all grown for seed, and all of excellent quality, were visited, as also were the farm buildings connected with the establishment.

The house of Vilmorin-Andrieux et Cie. dates from the middle of the last century, and has descended from father to son since 1774. It has continually prospered, and is now the oldest and most important seed house in France. In 1867 it had 90 employés, in 1878 it had 170, and in 1889 the total number at Paris, Reuilly, and Verrières was little short of 400. There is a horticultural establishment at Antibes (Alpes Maritimes) for plants too tender for the more northerly climates.

This house also had an extensive and interesting exhibit of its seeds, publications, and wax models upon the Quai d'Orsay. Their catalogues are numerous, very detailed, and profusely illustrated both by woodcuts and by colored lithographs designed by special artists. Their publications are important, and in many cases are consulted by farmers as authority. Their models of vegetables and fruits are also made by a special artist after a special process and are most lifelike in appearance.

The various exhibits of MM. Vilmorin-Andrieux et Cie. won for them at the Exposition three grand prizes, two gold medals, and one silver medal; and if especial notice is here given them it is to hold them up to our American seedsmen as an example worthy to be followed.

AGRICULTURAL DISTILLING.

"Agricultural distilling" is that which utilizes the products of the farms upon which it is practiced and returns to the farms its residues in the shape of utilizable material. Beets, potatoes, topinambours, fruits, wine, cider, etc., are products of the soil utilized in distilling, while the residues from these are applicable as fodder or fertilizing material. About one-fourth of all the grain distilled in France is of home production while nearly all the molasses so used is the product of her beet-sugar industry.

Farm distilleries are numerous in Germany and Austria, but are generally small, and the distilling ceases to be legally an agricul-

tural one when the amount of alcohol produced exceeds 1½ to 2 hectoliters daily. Such small distilleries do not exist in France, the average production of French "agricultural" distilleries being 8 hectoliters daily, so that this industry properly belongs under the designation of "grande culture."

Almost all French distilling is done upon beet molasses, while there are a few concerns using topinambours and grains. Formerly there were in the northern parts of France a number of unimportant grain distilleries in connection with cattle-raising farms, the cattle being nourished by the residues from the distillation during the winter, but these small industries have all been swept away by Belgian competition. In 1887 there were in France 154 agricultural distilleries of beet molasses, producing 144,044 hectoliters of *flegmes* (a watery distillate) without rectification, which number has probably not increased, while there were 116 such distilleries practicing complete rectification, and of these the number has slightly increased in 1889. Of all the production of alcohol in France, which amounts to 2,000,000 hectoliters annually, agricultural distillation produces only 150,000 to 200,000 hectoliters, or barely one-tenth.

In Germany distillation is almost exclusively agricultural, since even the largest establishments are not extensive and but few of them rectify their *flegmes*. There are about 3,500 distilleries of grain and from 5,500 to 6,000 of potatoes, while the annual production of alcohol is about 4,000,000 hectoliters. Thus the average production of each distillery in Germany is 400 to 500 hectoliters annually, while in France it is 3,800. In Austria the mean annual production of alcohol is 1,400,000 hectoliters, mostly from grain.

In its origin distilling was naturally an agricultural industry, both in France and Germany, the principal source of material in the former being derived from the vine while in the latter it was derived from grain. Distillation has been protected in Germany from its birth, as its great influence upon agriculture was recognized.

For many years distillation was operated in France upon products of the vine alone; in 1850 the total production (as far as officially known) was 900,000 hectoliters, of which only 76,000 were from grain or molasses. When the oidium appeared in 1852 the production of alcohol from the vine sunk from 824,000 to 165,000 hectoliters, and in order to make up this deficit the production from grain and molasses rose to 510,000 hectoliters. Fresh disasters attacked the vine, and after the oidium came the Phylloxera, so that now the production from the vine only reaches 25,000 to 30,000 hectoliters. Had any disease suddenly attacked the potato a similar state of affairs would have been seen in Germany.

About this period, 1853–'54, the agricultural distillation of the beet was introduced by Champonnois, and had the Government then afforded sufficient encouragement, and especially had serious tech-

nical education been applied to it, never would industrial distillation have been extended, and the agricultural branch of this industry would have prevailed, but commercial needs could not wait and want of funds obliged the utilization of immediate resources.

The advantages of agricultural distilling are, however, so great for the farmer that it is certain that this will in time develop. A comparison between these two classes of distilling shows that the expenses of labor and fuel are greater for agricultural work, since the production is less and the stills and other instruments less perfect; yet the farm hands will find useful employment in the winter. The value of the alcohol made in the agricultural way is less than that of an industrial factory by some 8 or 9 francs a hectoliter, but, on the other hand, the farm distiller who uses the products of his own cultivation saves the transport of his beets and has his pulps ready at hand, economies which may easily amount to 4 or 5 francs per hectoliter; he has also no rectification to pay for, no commercial risks to run, etc., which lessens his probable cost by another 4 or 5 francs. Therefore both systems may fairly be considered as equally advantageous. The agricultural distiller should, therefore, be aided in attaining this desirable state of his industry. It is incontestable, however, that the agricultural industry can not possess technical and scientific resources, such as are in the hands of industrial distillers. The manufacturer is also able to devote his whole time to his business, while as this industry is but a portion of all the work which goes on upon a farm, the cultivator can not give it his exclusive attention, his technical education is also often less complete.

Agricultural industries are even more of a public than a private element of prosperity; therefore, it is just that the State should bear its share of sacrifices to be made in their behalf, and not only is it just but simply reasonable that the coöperation of public power should contribute to raise the standard of public wealth, and whereas now the cultivator is able to gain information from national schools and agronomic stations concerning the value of fertilizers, the best kinds of instruments to use, and, in a word, concerning general agricultural practice, yet he is nowhere able to find any information as to industrial practice.

Agricultural distilling, is then, a most important factor in cultural prosperity and the distiller is the instrument of this prosperity, but is it generous or even equitable to ask him to undergo the whole expense and perform the whole labor? Shall he be only left a small share of the resources which he brings to the country?

It is important, then, that professional instruction in distilling should be given by the state with all the advantages which foreign states have already given to it; the state should elevate agricultural distilling to the level of industrial progress and guarantee it against errors prejudicial to its prosperity. Direct allowance should also

be accorded by special legislation, as has already been proposed by extra parliamentary commission. It would be desirable that the advantages offered by such legislation might be transferred by those interested into a sort of instrument of credit. Thus capital necessary for establishing such an industry might be obtained.

THE CIDER INDUSTRY.

This has great importance for several of the French departments. From 1877 to 1886 there was an annual mean production of 14,000,000 to 15,000,000 hectoliters, mostly in Normandy and Brittany. Cider is principally consumed upon the farms and in the towns of the provinces which produce it, but of late years its transportation to Paris and other large towns has commenced, especially since the advent of the Phylloxera and the increase in adulteration of wines have created a popular movement in its favor; the consumption at Paris has already risen from 50,000 to 300,000 hectoliters per annum. In addition, ciders have been admitted to the entrepôt at Paris upon the same conditions as wines and have been exhibited as other products are at the annual competitions. Agricultural societies have given corresponding importance to questions of cider and apple culture, and departmental societies have created experiment orchards, while the syndicates have turned their attention to the selection and propagation of the best fruit and to improving cider-fabrication. Apple orchards are now extending over parts of France formerly only cultivated with the vine, and it may be hoped that as the production of cider extends various regions will produce ciders of differing strength, taste, or aroma, as they do wines, or even that "grands crus" may be established.

The ease with which apples may be transported by boat or rail has permitted the construction of cider mills near large towns and at a distance from the orchards, and when apples are wanting in one region the deficit may easily be supplied from another; there is here an advantage over viticulture, as the grapes do not easily bear transport and must be pressed at the vineyard. It has been proposed that in order to avoid deception apples should be sold upon analysis, their amount of sugar, acidity, density of must, and other qualities being taken into account.

In 1883 ciders did not enjoy the same facility as to terms of transportation which wines did; a cask of wine weighing 1,000 kilos could be carried from Bordeaux to Rennes for 28.50 francs, while an equal cask of cider cost 41.70 francs for the same journey; since that time, however, owing to representations by some of the agricultural societies, this tariff has been changed and special rates for ciders have been adopted upon some of the railways.

THE DAIRY INDUSTRY.

In 1882 there were in France over 5,000,000 cows, giving 68,000,000 hectoliters of milk, which, at a mean of 12 francs per hectoliter, was worth over 800,000,000 francs; about 65,000,000 kilos of butter and 112,000,000 kilos of cheese were made yearly.

This important industry certainly merits attention, and yet until within a few years no progress had been made in it, but lately scientific methods have been employed and the production and management of milk, butter, and cheese have been improved. Several points, however, might receive further development.

Milk, after drawing from the cow, is generally preserved by cooling to within a few degrees of the freezing point, or by actual freezing, and many milk farms send milk thus cooled to great distances. Pasteurization is also resorted to. Properly constructed railway wagons are used which obviate the use of ice, but such wagons are still susceptible of improvement. A good milk can, convenient, light, easily cleaned, and so closed as to prevent fraud, is a desideratum. Milk is usually sold by measure or weight in France, but it would be preferable to sell it according to its contents of fatty matters; an easily applicable method of analysis is, however, wanting.

Butter has undergone, of late years, much improvement in manufacture, owing to the introduction of suitable machinery, such as the centrifugal separator, improved churns, etc., and France still occupies the first rank as a producer of superior butter, and the famous butter of Tsiguy has kept its reputation, though other French productions have been greatly improved. Nevertheless the exportation of French butter to England has fallen from 34,000,000 to 20,000,000 kilos, and the exportation to Holland, Germany, Italy, Ireland, and even to America has also decreased. The cause lies in the development of the dairy industry in Denmark, and also in the adulterations practiced by some unscrupulous French exporters. The principal substance used in the adulteration of butter is margarin. In 1882 the production of margarin was 35,000,000 kilos, while in 1885 this had increased to 115,000,000. A law passed in 1885 for the prevention of fraud in the butter industry is difficult of application, and it would be better to attack this nefarious industry with a tax of 2 francs per kilogram, which would kill it. In Sweden it has been decided to forbid the manufacture of margarin but the law is not yet promulgated; the dairy interest is paramount in that country and it is for the interest of the people to keep up the purity and the reputation of their products.

Great progress has been made in cheese-making in France, and new centers of manufacture are constantly springing up, especially in the western departments, and at present from 70 to 80 different

varieties of cheese are made in France, all finding a ready market. Much foreign cheese is still, however, imported into France, and so a considerable margin is left for the development of the French dairy industry.

More attention ought to be given to the utilization of dairy by-products (skim milk, buttermilk, whey, etc.), and it would be to employ some of them in the fattening of swine. The manufacture of condensed milk might also be advantageously carried on; although extensively in vogue in foreign lands, France does not possess a single factory for this industry, though such would be of immense benefit to her navy and her colonies.

In regard to the subjects discussed in the fourth section, the Congress was of the opinion that—(1) The law of 1884, concerning the selling of sugar beets, should be maintained. (2) The State should found a school of sugar-making upon an agricultural, commercial, and industrial basis. (3) That agricultural distilling should be subsidized by special legislation. (4) That the State should found a professional school of distilling in connection with that of sugar-making. (5) That ciders should have from the railway companies the same facilities for transport as wines. (6) That special instruction in cider-making should be organized, and that stations for the study of pomology should be founded. (7) That the Government should afford more encouragement to the dairy industry by either creating new societies or by subsidizing the old ones; also, that special dairy schools should be founded and that nomad instruction should be developed regarding this industry. (8) That a duty of 2 francs per kilogram be imposed upon margarine, and that a prize of 10,000 francs be instituted in order to encourage chemists to find a better method of detecting margarine in butter.

VITICULTURE AND SERICICULTURE.

When the Industrial Congress met at the Exposition of 1878 the Phylloxera was still raging in France and the struggle against it seemed yet doubtful of success. Before the appearance of this insect the vineyards of France extended over 2,500,000 hectares and annually yielded 50,000,000 hectoliters of wine, representing a value of one and a half milliards of francs, but this production had decreased one-half, and one million hectares of vineyards had been destroyed. In 1889, however, the Congress met under happier auspices, for, after having been menaced with total destruction in Europe, viticulture had been rescued from its peril. The defense of the vine had been assured and the reconstruction of the vineyards was only a question of time. Much, however, remains to be accomplished, and there were several subjects of importance to be brought before the Congress.

As these subjects are fully treated of under Class 75 in my report

as expert, (Chapter VI,) it is only necessary here to embody the conclusions of the Congress:

(1) That a premium of 100,000 francs should be offered for the discovery of a Franco-American hybrid which will resist Phylloxera and thrive and bear good fruit in marly soils. (2) That official statistics should be published by Government upon the extent of lands suited to the plantation of submersible vineyards, together with an enumeration of such lands and the physical analysis of their soils. (3) That similar statistics should be published concerning sandy tracts similar to those of Aigues Mortes, with indications of underlying water courses. (4) That an international commission of savants should receive from the Government a mission to study the conditions of vinification in Algeria, and the means of rendering the fermentation of musts in warm climates more regular; also that an experimental station to this end be established in Algeria.

French sericiculture has met with serious troubles in its foreign relations. In Italy the newspapers have made a crusade against the importation of French silkworm eggs and advocate the imposition of a prohibitive duty. This duty has not been imposed, but the French industry has suffered considerable loss in consequence of the attack. The Turkish Government has hampered the importation of French eggs with vexatious and often unnecessary regulations, while in Bulgaria the market is completely closed against France. The remedy for all these evils is to be found in conciliation by the intervention of ambassadors and consuls.

The following resolutions were passed in the interest of sericiculture: (1) The prefects of silk-raising departments should be instructed to publish circulars reminding raisers of silkworms that it is for their interest to destroy by fires, or by burial in the earth, bodies of diseased (muscardinés) silkworms, with the least possible delay. (2) In order to give more rapid development to French sericiculture nurseries for mulberry trees should be created in each silk-raising department and prizes of encouragement should be given to landowners or farmers who plant private nurseries. (3) The sericicultural stations at Montpellier should, in order to study all interesting technical questions, be provided with an experiment field for mulberry trees, with an experimental silkworm-raising room, where various races might be examined, with a complete laboratory for the study of silk, and, finally, with a cooling chamber for hibernation of eggs.

VISIT TO THE FARM AT ARCY.

[Report by AMORY AUSTIN.]

In connection with this Congress an excursion was made on Sunday, July 7, to the celebrated dairy farm of Arcy-en-Brie. A special train was provided by the courtesy of the proprietor, M. Louis Nic-

olas, and a large party of guests, representing the agricultural interests of all countries, spent the day in inspecting the farm. This farm is situated near Chaumes (Seine-et-Marne), at about 52 kilometers (32 miles) to the east of Paris and about 2 kilometers from a station upon the railway to Mulhouse. It lies upon a slightly undulating table-land at an average height of 117 meters (384 feet) above the sea level, and comprises about 487 hectares (1,209 acres) of land, all of which is under cultivation. The domain was acquired gradually by the proprietor, and some idea of the *morcellement* or subdivision of French fields may be formed when it is stated that these 489 hectares were originally divided into 81 separate lots, measuring from four-tenths to 132 hectares, (1 to 326 acres), or averaging 6 hectares (15 acres) each.

The soil is a silicious-clayey one, varying in depth from 0.20 to 0.50 meter (8 to 20 inches) with a subsoil of clay, gravel, and ferruginous sand. Several years ago this land was a byword in the neighborhood for its poor quality; its cereal crops were meager, and much of the land was still uncultivated, while experiments upon improving its quality by crops of clover, lucern, and sugar beet utterly failed. To-day, however, a thorough system of drainage and a judicious application of chemical fertilizers have brought about a high state of cultivation, so that the farm now comprises some of the best land in the Department, and is held up as an example of agricultural success.

The clay soil, which was almost unapproachable after heavy rains, was relieved by a system of drainage which occupied seven years in completion and cost 100,000 francs; stones, and in some cases large bowlders, were removed, and the want of lime was supplied by a thorough application of marl. The first application of fertilizers was of 4,793 tonnes of Paris night soil, together with guano and farmyard manure; this was followed in 1873 by several tonnes of chemical fertilizers of various sorts. These, perhaps, were not well chosen, for the utmost they could produce was from 14 to 21 hectoliters of wheat, or from 19 to 33 of oats, per hectare, and it was evident that improvement might still be made.

M. Nicolas therefore, in 1877, sought the aid of the celebrated agricultural chemist M. Joulie, and, following his counsels, has succeeded in making the farm what it now is, and in raising the yield of wheat to over 35 hectoliters per hectare. The system followed by M. Joulie was explained by him in person to the visitors at the farm, and may be recorded here.

An analysis of the soil under consideration is taken as the basis of the treatment to be applied. Such analyses have been customary for many years, but hitherto agricultural practice has not taken full advantage of them. Not only should the contents of the soil in useful elements be known, but also the practical conclusions to be drawn

from such analyses. Therefore M. Joulie has adopted a uniform method of analysis, thus obtaining comparative results, and he also compares each analysis with the cultural results obtained from the soil both by ordinary cultivation and by the aid of chemical fertilizers; or, in other words, he compares the analysis of the soil with its agricultural history. Since 1872 he had in this way examined 2,775 samples of soils coming from all portions of France, and even from abroad. By these means an approximate idea at least may be formed as to what constitutes an average fertile, arable soil, and all soils may be compared to this as a standard.

M. Joulie regards as a perfect soil, from a chemical point of view, one which, in addition to the necessary physical properties, contains, in a state to be successively assimilated by a long succession of crops, the following quantities of essential elements in a hectare of 20 centimeters depth: Phosphoric acid, 4,000 kilograms; potash, 10,000 kilograms; lime, 100,000 kilograms; magnesia, 5,000 kilograms; nitrogen, 4,000 kilograms.

The deficiencies of the soil in one element or another may thus be detected, and fertilizers may be applied to remedy them; and, as an additional precaution, the analysis of the crop obtained may be made. Thus, the soil of the Ferme d'Arcy, being analyzed in 1877, was found to be more or less wanting in all the elements useful to vegetation. Of these, phosphoric acid was particularly lacking in the upper layer (20 centimeters), and there was even less of it at a greater depth; while potash, on the contrary, increased in the lower layers though it was notably wanting in the upper layers. The addition of phosphates and of potash salts, and the use of lucern to bring the potash to the surface, were therefore indicated. Lime in this soil was only a quarter of what it should have been, notwithstanding the large quantities of marl which had been added; slight, though frequent, additions of lime (*chaulage*) were thus indicated.

Magnesia was present in sufficient quantity at the surface, and increased as lower depths were reached, so that there was no occasion to give it further consideration. Finally, nitrogen was not half as abundant as it should have been, and therefore it was decided to apply it in its most active form (as nitrate of soda) in suitable quantities.

The consequences of the above treatment were that fields which in 1875 gave 14.16 hectoliters of wheat per hectare gave 29.64 hectoliters in 1880, and 35.57 in 1887, the average from 1880 to 1889 being 31.19 hectoliters. The proportion of grain to straw, which was 30 to 70 in 1875, increased to 40 to 60 in eight years.

Oats which yielded 19 hectoliters in 1875, yielded 34 in 1877 and 50 in 1878, and averaged 54.22 hectoliters from 1880 to 1889.

During these same years forage plants so increased that the farm, after having ceased to buy them in 1876, began to sell important

quantities of them, even though forage plants were made of secondary importance to cereals. In 1880 the area devoted to cereals was 165.56 hectares, which had increased to 199.56 in 1881, and from 167.12 in 1882 had become limited to 17.81 hectares in 1889.

The farm is, however, carried on especially as a dairy farm, and everything is conducted with a view to producing the best possible quality of milk. There were in 1888 about 150 cows upon the farm, and 10 bulls. The cows are for the most part of the Norman or Cotentin breed, and are quite large; they almost all come from Normandy itself, and are bought singly from the farmers of that district. Great care is exercised in their selection, and each new cow is submitted to "quarantine" for six weeks at a distance from the main

FIG. 208—Milk jars used at Ferme d'Arcy.

herd. The cows are well nourished. In winter they receive 35 kilos (77 pounds) of forage beets, 8 kilos of straw, and 6 kilos of hay per diem, with a small proportion of bran and cotton-seed cake; in summer the forage beets are omitted, the cows being daily pastured, but housed at night, when they receive straw, green fodder (lucern, etc.), bran, etc. The feeding and care of each cow costs 1.52 francs (29.3 cents) per diem or 554.80 francs (about $107) per annum. The average yield of milk per animal is from 9 to 10½ liters daily, this high figure having been obtained by the method of selecting and feeding in practice at the farm. At the above high cost of feeding it does not pay to keep a cow which does not give over 6 liters of

milk per day, and therefore such animals are at once sold out of the farm. Each cow has a number, and a special record is kept of everything concerning her; upon the first day of each month the quantity of milk given by each cow is exactly measured, and this, with her description, weight, dates of service, calving, etc., go to form the record.

The bulls, also of the Cotentin race, are raised at the farm. They are put to service at the age of from 16 to 18 months, and are sent to the butcher at from 32 to 36 months. A few Jersey cows are

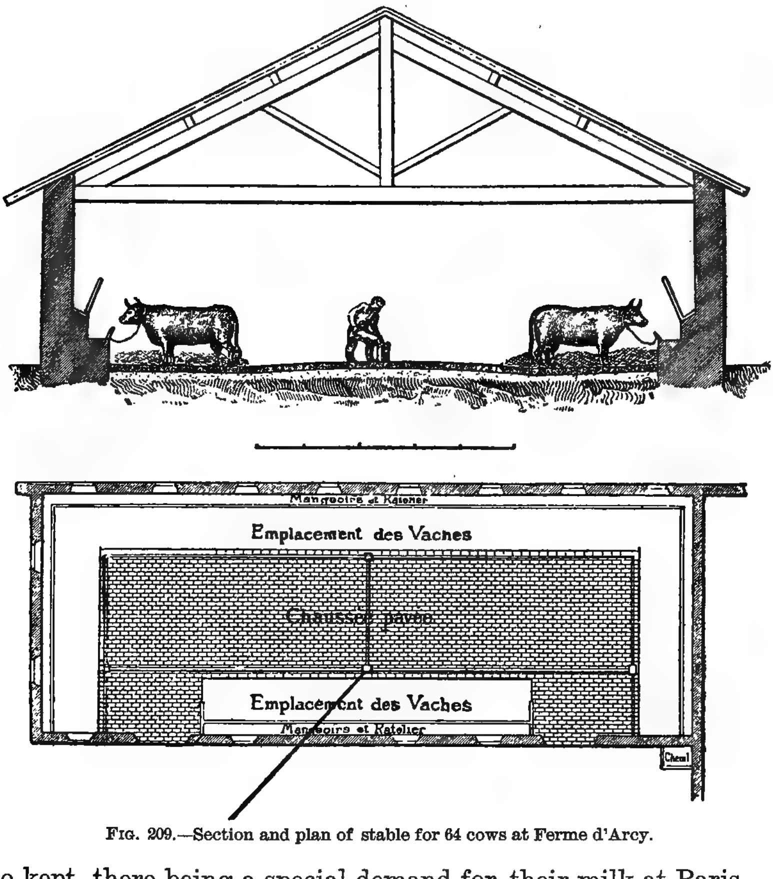

FIG. 209.—Section and plan of stable for 64 cows at Ferme d'Arcy.

also kept, there being a special demand for their milk at Paris. A fine young Jersey bull and several particularly fine Jersey cows were seen at the farm during the visit. About 35 horses, mostly Percherons, are employed at the farm, and a dozen oxen of the Charolais breed.

The treatment of the milk is as follows: The morning's milk, kept cool throughout the day in large wrought-iron vessels, is mixed with the evening supply, and the whole milk, without skimming, is put, not into metallic cans, but into opaque glass jars of one-half, 1,

or 2 liters capacity (Fig. 208), which are sealed, and sent directly to Paris by a special refrigerator car, the temperature of which is kept constant at 5° Centigrade (41° F.) and are delivered sealed to the consumer. The empty jars are collected and returned to the farm. This system was invented by M. Nicolas in 1873, and has spread over Europe and in America. The retail price of this milk is about 70 centimes per liter (about 13½ cents a quart). The Jersey milk commands 1 franc per liter.

The farm buildings, which are of stone, with tiled roofs, were constructed in 1873–'74, and are built in the form of a hollow square around a central courtyard. The annexed figure shows their construction. It will be observed that they are entirely without cellars. (Fig. 209.) These buildings were reproduced at the Exposition by a well-executed model one-fifteenth the size of the original.

Plans and drawings and specimens of the crops grown were also shown, and the famous milk itself could be tasted upon the Quai d'Orsay.

Of the land under cultivation in 1889, about two-thirds were sown with cereals, principally autumn and March wheats, the other third being devoted to forage crops, principally lucern, with forage beets, clover, grasses, carrots, and potatoes. Lucern grows well at Arcy, as it has the deep subsoil to work in.

The water of the farm is supplied by an artesian well 60 meters (197 feet) deep.

From forty to fifty hands are employed at the farm, their wages varying from 5 francs to 1.75 francs per day, without board. At haying time and harvest this number is increased.

After a thorough inspection of the farm, with its buildings, live stock, dairies, and plantations, an elaborate breakfast was served in one of the granaries. This was presided over by M. Méline, and speeches and toasts after the repast were in order.

Among other countries, the president alluded to the United States in most complimentary words, and called upon Prof. Riley to respond. I translate from the official report his response, made in French, and received with warm applause:

TOAST OF MR. RILEY, DELEGATE FROM THE UNITED STATES.

Mr. President and gentlemen of the International Agricultural Congress: You honor me greatly by giving me the floor, and I would that, in order that I might speak more befittingly of the United States, I had been previously notified.

Between the people of the United States and the French people there is not only the sympathy of republicanism, but also that kindly feeling which exists between two nations which have always been on friendly terms. The Americans, as you know, are very practical, but at the same time they combine science with practice.

This alliance appears in the history of the telegraph, of the telephone, of the phonograph, of electric lighting, and of many other inventions, and now we see it confirmed in the domain of agriculture in improved methods, inventions for increas-

ing the production of the soil, and discoveries for the protection of agricultural products.

It is the marriage of science with practice which we have to-day seen, and which we now verify. The work of M. Joulie and M. Nicolas represents, in fact, such a marriage.

For us Americans, who are accustomed to see your fields so well cultivated—but rather as those of small proprietors, and resembling gardens—the broad fields and grand scale of operations upon the Arcy Farm are a revelation, but a revelation which also shows the value of methods which are becoming more and more popular in the United States.

M. Sagnier, beside me here, would have me speak of what we have done for French viticulture in the way of American vines and spraying machines, but the part which I have taken therein forbids.

Finally, gentlemen, though I presume to speak with some pride of what America has done for the advancement of agriculture, it is much more agreeable to me to say to the other foreigners here present that we owe to France many of our best experiments in agricultural methods, as well as in horticulture, sericiculture, and viticulture, and in which we recognize her absolute superiority.

It is the same in regard to agricultural instruction and administration. We follow the lead of France, for this very year we have established a Secretaryship of Agriculture, forming a part of the Cabinet, and it is the example of France which has led us thereto.

The labors of M. Tisserand, director of agriculture, which we know so well in the United States, and those of our president, M. Méline, with whom I had the honor of corresponding when he was your minister of agriculture, as well as those of many others I could name had I time, have produced such good results in the United States that it is a veritable pleasure to meet these eminent men here and a great honor to drink their health.

SECTION II.

REPORTS

ON THE

AGRICULTURAL RESOURCES OF THE UNITED STATES.

CHAPTER XI.

MEAT INDUSTRIES OF THE UNITED STATES.

By H. C. CLARK.

It was the expressed desire of the United States House of Representatives, in accepting the invitation of the French Republic to participate in the International Exposition to be held in Paris during the year 1889, that an authentic statement of the meat industries of the United States, and the method therein pursued, should be prepared for general circulation at the Exposition, with the view of removing or correcting any erroneous impressions which might prevail as to the wholesomeness of products which, prior to the year 1882, had found an unrestricted market in all the chief countries of Europe. In accordance with the instructions thus conveyed, the subjoined statement has been prepared under the direction of the Commissioner of Agriculture, to whom Congress confided general supervision over this branch of the national exhibit.

Meat and dairy produce take third rank among the surplus productions which the United States exports for consumption abroad. Cotton and breadstuffs alone exceed them in value. This relative position is maintained, notwithstanding a decrease of 43 per cent since 1881, in the exportation of hog products—due to prohibitory legislation by other nations. The exportation of these products at its greatest development in 1881 amounted to $104,660,000. During the past year (1888) it was $59,229,000. The business of "pork packing," as it is termed, not only remains a leading factor in the foreign commerce of the United States, but it is third in importance among the domestic industrial pursuits of the country. The consumption of hog products in the United States is five times greater than the whole amount of such products exported. This fact gives home importance to the sanitary regulation of the business and of itself insures the exercise of care in the production of an article of food which enters so largely into the daily life of sixty millions of people. The immense amount of capital invested and the commercial necessity of protecting it from the risk of impairment supply additional reasons for surrounding the trade with every wholesome precaution which science can devise or untiring energy suggest.

Next in importance to the business of pork packing among the meat industries of the United States is the trade in dressed beef. The average value of the exportation of dressed beef during the last ten years has been over $17,000,000 per annum —exclusive of the export trade in live beef cattle. During the past year (1888) the exportation of dressed beef amounted to $18,440,000, and of live cattle to $11,577,000.

RAISING AND FEEDING CATTLE AND HOGS.

The chief supply of beef cattle brought to shipment is derived from the grass ranges of Texas and the Indian Territory, from the State of Colorado, and from the Terri-

tories of Utah, Montana, Idaho, Wyoming, and New Mexico. Other cattle, not exclusively grass-fed, come from the corn-growing belt, comprising the States of Illinois, Indiana, Kentucky, Iowa, Kansas, Michigan, Nebraska, Minnesota, and the Territory of Dakota. Cattle-raising in the United States is a progressive industry, engaging a large amount of capital and skill. Nearly all the choice breeds known are represented among the herds brought to market. The so-called "native" cattle—descendants of the stock which the early Spanish explorers turned loose in the sixteenth century—have been reinforced by the introduction of finely bred Short Horns, Herefords, Polled Angus, and other improved cattle from the stock farms of Europe. Animals of the purest breed, which have transmitted their pedigrees unimpaired, are to be found in nearly all the States.

Most of the hogs handled in the packing houses of the West are raised in Illinois, Iowa, Kansas, Missouri, Wisconsin, Nebraska, Ohio, and Indiana. These are known as the "corn-surplus" States, where so much Indian corn is grown that it is cheaper to send it to market in the form of hog-flesh than to attempt its direct transportation in the kernel. The hogs raised in these States are almost exclusively of high grade Berkshire and Poland-China breeds, unsurpassed for purity of strain, and all the qualities most esteemed for meat-raising purposes. The method of feeding them is clean and simple. As soon as they are able to shift for themselves, the young pigs are turned out to pasture, being also fed with corn at certain hours of the day. At the age of about six months the pigs are brought in and penned, and the work of fattening them for market commences. They are then no longer called "pigs"—a name technically applied only to young animals less than six months old—but become the "hogs" of commerce. They are supplied in their pens with all the corn they can eat, and are given access to an abundance of clear, fresh water—this last being found by experience to be an essential requisite to the raising of the best quality of pork. In Kentucky and other States where distilled spirits are manufactured on a large scale, hogs are sometimes fed on the grain "slops." The flesh of animals so nourished is soft, not adapted for curing, and cannot be shipped to foreign markets. The hogs that are sent to the great pork-packing centers have been fed almost exclusively on grass, mast, and Indian corn. When they have reached a weight ranging from 150 to 450 pounds per head they are ready for market, preference being given to hogs of less than 200 pounds or 90 kilograms. The farmer hauls them in wagons or sleighs, according to the season, to the nearest railway station and consigns them to some commission merchant in Chicago, Cincinnati, St. Louis, or other pork-packing city. The hogs are carried by the railroads in well ventilated covered cars, and are tended and fed and watered by the way with more or less care. Precautions are taken to protect them from bruises or other injuries. The mark of a whip lash or of a prodding pole is sufficient to secure the rejection of the animal by the packer. For this reason they are hauled to the railroad instead of being driven.

METHODS OF TRANSPORTATION.

Marked improvements have been made of late years in the methods of transporting live cattle and hogs to market. This applies especially to cattle ; there is still room for further development in the manner of carrying hogs, so as to insure greater comfort and immunity from accidental death or injury. Formerly animals of all grades were carried in square open boxes, called cattle cars, into which they were crowded without much regard for bruises or broken limbs, and with little or no provision for feeding or watering them on the road. That system, happily, has been changed. Improved "palace" and "stable" cars have replaced the square-box monstrosities in the carrying of all the best grades of cattle. The aim has been, not only to provide means for properly feeding and watering the animals en route,

but to protect them as far as possible from injury and loss of weight in transit, and to reduce the time occupied by the journey to the briefest possible space. Ample compensation for the extra cost thus incurred is found in the excellent condition of the cattle when landed at their destination.

One of the best equipped of the palace-car companies engaged in carrying live stock to market recently transported a herd of cattle from Idaho Territory to New York City, a distance of 2,500 miles, in 107 hours, and on disembarkation the cattle showed an average shrinkage of less than 20 pounds per head, or barely 2½ per cent, as the result of the journey. The cars used by this company are constructed on the model of the Pullman passenger cars, with 42-inch steel-tired papier-maché wheels, elliptic springs, Westinghouse air-brakes, and automatic couplers, so as to prevent any jarring at starting or stopping. The cattle are driven into these cars in the ordinary way, twenty to a car, and are then boxed off into separate compartments—one to each if desired—by transverse slats lowered from the roof. Each stall affords room for the animal to lie down at will. Food is dropped from a bin in the roof into mangers let into the sides of the cars, and water is supplied in troughs, similarly placed, from pipes running round the outside of the car and connecting with a tank in the rear. Fan wheels at each end and a double roof keep the cars well ventilated in the warmest weather. This line has over 500 palace cars in successful operation. The method of construction is shown in the accompanying sketch (Fig. 210).

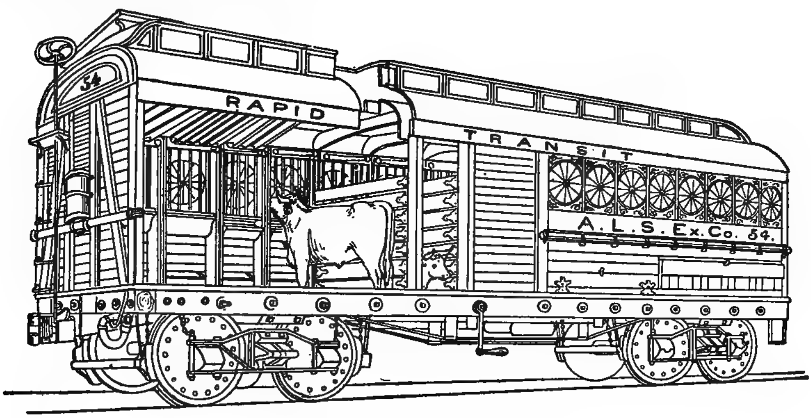

Fig. 210.—Plan of palace stable car.

The "stable" cars are also furnished with hayracks and water-troughs—the former filled at the starting-point and the latter replenished at regular watering stations on the route. Each stable car will hold from eighteen to twenty steers of the best grade. One company has fourteen hundred stable cars running on Western roads bringing live stock to market in Chicago.

STOCK YARD AND PACKING HOUSES OF CHICAGO.

The center of the meat-packing industry of the United States is Chicago. It is by far the largest shipping point for dressed beef and canned meats, and it also maintains a decided lead in the handling of hog products. The course of business in Cincinnati and St. Louis is similar to that in Chicago. Extensive packing houses established at Omaha (Nebraska), Kansas City (Missouri), and other points are largely controlled by Chicago capital, and the method of doing business there pursued is substantially the same. The operations of the stock yard and packing

houses of Chicago have therefore been selected for description as illustrative of the meat industries of the United States.

The plant of the Union Stock Yard and Transit Company of Chicago covers 350 acres in the town of Lake, 4 miles from Chicago city. The establishments of the meat packers, adjoining and connected with the stock yard, but forming a separate jurisdiction, known as "Packing Town," cover a like area; so that, in all, 700 acres of railroad tracks, pens, and buildings are devoted to the purposes of transporting, handling, and slaughtering animals and packing meats.

The stock yard has a capacity to accommodate at one time 25,000 cattle and 100,000 hogs. Practically the largest receipts in any one day have been 20,000 cattle and 66,000 hogs. The total receipts in the year 1888 were 2,611,543 cattle, and 4,921,712 hogs. In addition to these, and outside the scope of this article, the yard has a capacity for receiving and handling a large number of sheep, and actually received over 1,500,000 in 1888. Twenty different lines of railroad concentrate in the yard, connecting with all points north, south, east, and west. The Stock Yard Company owns and maintains a double track, embracing 150 miles of main track running all round the city and connecting with every line that enters Chicago. It has its own water service and fire department; it provides a three hundred room hotel, and a bank with a capital of $750,000; and during the year 1888, with low prices prevailing, its business aggregated $250,000,000.

At night the yard is lighted by electricity and securely policed. Cattle begin to arrive each day, Sundays excepted, between 7 and 8 o'clock. From that hour until 4 or 5 in the afternoon there is one continuous rush of business. Drovers, mounted on bronchos, or hardy Montana horses, or piebald Texas ponies, ride rapidly in every direction, cutting out stray cattle here, heading off a herd which is moving in a wrong direction there, and almost drowning with their shouts the bellowing of the cattle. (See Plates XVI, XVII, and XVIII).

There are six landing platforms, but only two gates, through which all cattle landed by the railroad companies must pass to reach the stock pens. At each of these gates a State health inspector is stationed. These health officers are practical butchers, whose experience enables them readily to detect any cattle or hogs that may be suffering from disease, or not in fit condition for human food. Every animal is subject to their inspection before it enters the stock yard.

The largest consignments of corn-fed cattle are received in the early spring months. For the remainder of the year the supply is mainly drawn from the vast cattle ranches of Texas and the far Western States and Territories. The stock are consigned to commission houses, of whom there are about two hundred doing business at the stock yard. Each railroad company has an office on the platform, at which the stock conveyed by it are unloaded. When a train of cattle or hogs arrives by that railroad it is bulletined at the office—that is, a notice is posted showing the consignor, the consignee, and the number of cattle or swine, as the case may be. After the cattle or hogs have passed the health officer they are taken possession of by the Stock Yard Company, which pays the freight and puts the stock in different pens according to ownership. The commission merchant to whom the stock are consigned gives to the Company his orders concerning the feeding and watering of them. Whatever quality or quantity of food is desired is supplied by the Company, which also furnishes men to see that the animals are properly cared for. When the cattle or hogs have been conducted to their pens the buyers of the different packing houses—trusted and experienced men, receiving salaries ranging from $5,000 to $7,000 a year—examine the stock and put a price upon it of so much per 100 pounds as it stands. They exercise the right of selection, and rigorously exclude any animals which appear to have been injured, or which seem in imperfect health or condition, or of inferior quality to the grade for which their orders call. There is a weigher in attendance on each buyer, who follows the cattle when

CHICAGO STOCK-YARDS; GENERAL VIEW LOOKING WEST.

GENERAL VIEW OF CHICAGO STOCK-YARDS; COVERED RUNWAY AND PENS.

FEEDING AND WATERING CATTLE AT CHICAGO STOCK-YARDS.

UNLOADING HOGS FROM CARS.

SHEEP ON WAY TO SLAUGHTER-HOUSE.

they go to the scales and subjects them to further scrutiny. This is done when the buyers and the commission merchants have agreed upon terms. The animals are weighed in the scale house by the Stock Yard Company, a carload at a time, and a stock ticket is made out, which decides the weight between buyer and seller. After being weighed the stock is driven back to the pens. The commission merchant settles with the company for the freight and the feeding and storage of the cattle, which are then turned over to the purchasers. Hogs are driven to the packing houses over long, elevated wooden chutes or driveways, substantially built and roofed over, which lead directly from the pens to the slaughterhouses; cattle and sheep are usually driven on the level. In driving and handling stock in the yard as little violence is used as practicable. The office of the Illinois Humane Society is a conspicuous object at the entrance of the grounds, and the agents of that society are prompt to repress and punish cruelty.

In spite of every precaution some dead or maimed cattle are found in almost every train load. The mortality among hogs in transit is also unavoidably great. The latter animals when ready for shipment are, in homely phrase, "fat as butter." In the course of the journey some of them get down in the cars and are unable to get up again, and are trampled to death or smothered by their companions. Dead cattle and hogs entering the stock yard in this way never pass into consumption as food in any form. A company known as the Union Rendering Company, which, in fact, is an offshoot of the Stock Yard Company, has the exclusive right of receiving all such dead animals, at a price so profitable to itself that it keeps stern guard over the arriving trains and suffers no dead animal to escape. By that company they are rendered down into grease, glue, and fertilizers. There is but one way in which animals intended for human food can get into the packing houses, and that is alive and on their own feet. From the time they enter at the slaughtering end until they emerge at the other end, dressed, cured, salted, or canned, there is a continuous chain of manipulation carried on by organized gangs of workmen, each under the control of a foreman, which could not be broken in upon without disarranging the whole course of business and attracting general attention. It must be obvious, without further demonstration, that, with the enormous capital involved, and dependent for its continued profitable employment on the maintenance of public confidence, no packer, even if he could do so without detection, would endanger the safety of millions of dollars for the insignificant profit to be derived from handling a limited number of diseased or dead animals in his business.

SLAUGHTERING AND DRESSING CATTLE.

Cattle purchased for packing are driven into pens at the slaughterhouse, and detained there for some hours until they are cool and free from all excitement. In hot weather water is frequently played upon them through hose. When they are cool and quiet they are allowed to wander, or are gently urged down a chute which opens into a number of little pens, each just large enough to hold one fat steer, without allowing him room to turn round. These are the felling pens. They are opened or closed at either end by a trap door. Sometimes the cattle find their own way into the pens through the open doors, but in any case they need but little urging to induce them to enter. Once inside they never come out again alive. Commanding each pen is a narrow stage, roughly put together with a few boards and a gang plank leading from pen to pen, raised about a foot above the level of the animal's head. On this stage the executioner stands, sledge hammer in hand. He watches his opportunity until he sees the doomed steer standing perfectly still with its head in the right position, and then carefully taking aim he delivers one crushing blow in the middle of the forehead. Without groan or cry the animal drops, stunned and insensible, the sound of its fall reaching the ear almost at the same instant as the crash of the blow. The trapdoor in front of the pen is quickly

raised, a chain attached to steam machinery is thrown over the animal's horns and it is dragged out upon the slaughtering floor. There one or more blows are given it and its throat is cut, to complete the work begun in this felling pen, but almost invariably the animal after it is first dropped evinces no further sign of life except a convulsive kick when the spinal marrow is severed. As soon as the throat is cut the skin of the head is flayed and thrown back on the hide; the head itself is cut off; a chain is passed round the hind legs, and the animal is hoisted from the ground and suspended to a steel bar or "run" over a wooden gutter running down the middle of the floor, and is allowed to hang there until all the blood has drained out of its body. This takes from ten to fifteen minutes. The whole process of felling, slaughtering, decapitating, and hanging up on the "run" to bleed has occupied not longer than a minute and a half. The thorough method adopted of bleeding the animal is an important feature in the system of slaughtering. All the arteries of the neck being severed, and the animal being hung up, neck downwards, whilst the circulation is still hot and active, there is no possibility of the blood coagulating in the carcass, as in the case of cattle allowed to lie on the floor until they are half skinned and partly dressed.

It is a marked peculiarity of the system adopted at the great packing houses, in some of which two or three thousand cattle are killed in a day, that the victims manifest none of the restiveness and painfully obvious alarm observable in cattle dragged into a country slaughterhouse to be butchered. They seem to have no premonition of their fate until felled by the sledge hammer, and after that there are no signs of consciousness. It is murder reduced to a fine art. There is so little unusual or alarming noise that even the steer in the next pen to the one that is being slaughtered shows no uneasiness and betrays no anticipation that it is its turn next. Other methods of killing—shooting with a rifle, or spearing the base of the brain—have been tried, but felling with a sledge hammer, when skillfully done, is found by experience to be the most speedy and humane method, and it is now generally followed.

After the carcass of the slaughtered steer has been thoroughly drained it is carried along on the "run" to the skinning bed, where it is lowered on its back and split from the breast-bone backward, and the skin is loosened from the sides by a peculiar free sweep of the knife requiring long practice to accomplish. While in this position the caul fat is removed and applied to purposes hereafter described in connection with the manufacture of oleo oil. Then the animal is again hoisted to the "run," and the paunch and intestines, etc., are taken out and the hide removed, after which it is split down the back and becomes two sides of beef. These are carried on wheels or runners to another part of the slaughterhouse, where the flesh is thoroughly washed on the inside, and wiped on the outside with a clean, dry cloth. It is afterwards permitted to remain in the ante room of the cooling room until the animal heat has gradually passed away. The beef is then run into the cooling room and chilled for from twenty to forty-eight hours, according to weight. The largest packing houses have four of these cooling rooms, each with a capacity of 900 carcasses, but usually, in order to insure free circulation of air, not more than 600 beeves are hung in any one room at the same time. A uniform temperature of about 38 degrees F. is maintained in the cooling rooms by means of artificially iced brine, pumped by powerful engines into pipes running round the sides of the room. Electric lamps penetrate to every corner of the building, and give weird effects of light and shade as the different gangs of white-frocked workmen move about among the ruddy carcasses. (See Plate XXI).

Between the cooling rooms and the platform, where the refrigerator cars are drawn up ready to convey the dressed beef to its destination, is the shipping room. The meat, after being quartered, is here subjected to rigid inspection before shipment, so that none showing any blemish shall pass into the car. These refrigerator

DRESSING CARCASSES OF CATTLE, MORRIS'S SLAUGHTER-HOUSE.

cars are nearly 30 feet long by 8 feet wide, with a space of over 7 feet between the floor and the crossbars on which the meat is to be hung, and a further space of 14 inches between the crossbars and the roof. Thus, the hooks being placed sufficiently wide apart for this purpose, air can freely pass all round the beef while in transit. Each car will hold about 30 carcasses of selected beef averaging 650 pounds. each. The hind quarters are hung at one end of the car and the fore quarters at the other. In the ends of the car there are four or more galvanized iron tanks, each capable of holding two tons of ice. These are filled from the outside, through small hatchways, with a mixture of pounded ice and coarse salt, which is renewed at designated stations on the route as required. The tanks thus filled reduce the temperature to from 36 to 38 degress F. in the closed car. The air, as it comes in contact with the tanks, becomes chilled, and descends, displacing the lighter and warmer air which naturally rises and becomes in turn chilled, and thus a constant current of rarified air is maintained in the car, which keeps the meat in perfect condition without its ever having been frozen or coming in direct contact with ice.

An impression of the extent of the dressed beef trade of Chicago can be gathered from a statement of the business done by the four leading firms. During the year 1888 Armour & Co. slaughtered for dressed beef and canning purposes 561,000 cattle; Swift & Co., for dressed beef exclusively, used 484,000 cattle; Nelson Morris and the Fairbank Canning Company, slaughtered 468,000 cattle; and the Hammond Dressed Beef Company, 220,000 cattle. There are other firms and companies engaged in the business of packing and canning beef, but not on so broad a basis. The total business of Armour & Co. last year amounted to $55,000,000.

The extensive scale upon which operations are carried on gives value even to those parts of the animal heretofore regarded as worthless, when accumulated in such bulk. Nothing is wasted. The feet and heads, the latter of which in past years were often buried on the prairies, are converted into glue and fertilizers. The hoofs and horns, bones, etc., are shipped East and made into knife handles and various ornaments. The blood drained from the slaughtered animals is caught, cooked, and dried, and becomes a valuable fertilizer. The skins of the intestines, properly cleaned, form sausage casings, the offal and refuse go to the fertilizer factory, and even the floor washings, collected in the sewers, yield wagon grease. The hides are sold to the tanners, and form a very valuable item. There have been occasions when hides were worth 10 cents a pound, and beef only 5 cents a pound at wholesale. The glue and fertilizer factory in which Armour & Co. utilize their refuse products covers 11 acres, employs 500 men, and turned out, in 1888, 6,000,000 pounds of glue, 14,000,000 pounds of fertilizers, and 4,000,000 pounds of grease. It is this concentration of force, and economy in handling, which gives the large packers their advantage, and enables them to compete so successfully in the markets of the world.

SLAUGHTERING AND PACKING HOGS.

When a drove of hogs has been purchased for a packing house, and all the preliminary obligations of health inspection, weighing, etc., have been complied with, they are driven up an inclined plane to a covered elevated runway, leading to the pens of the particular packing house which is to be their final destination. Here they are given time to rest and cool off, and become acquainted with their new surroundings. After sufficient interval has elapsed for this purpose—usually from twenty-four to forty-eight hours—during which time they are fed with corn and carefully watered, a man, known as the "shackler," enters the pens, and, lifting a hind leg of each unsuspecting animal slips over it a stout oval iron ring, which lodges just above the joint. Into this ring at the proper time he inserts the smaller end of a double hook attached to a chain. This is quickly drawn up by machinery, and lifts the astonished and protesting hog, head downwards, 8 or 10 feet from the ground. The larger end of the hook is thrown across an inclined steel rod or "run," and a gen-

tle push sends the hog sliding along this rod to a platform where stands the "sticker," knife in hand. With marvelous celerity—frequently at the rate of eight or ten a minute—he plunges the sharp-pointed keen-edged weapon into the animal's gullet, and makes a longitudinal upward cut, of 2 to 3 inches in length, from which the blood immediately gushes like water from a rain spout. A touch from the sticker's hand sends the dying hog sliding a few feet further. There it is allowed to hang, squealing with scarcely abated vigor, for about five minutes, until all the blood has drained from its body. Then, almost before the the last gasp of life has left its quivering carcass, it is plunged off the end of the rod into a cauldron of boiling water, in which it is immersed just long enough to loosen the hair from its hide. It is lifted out of the scalding vat by an ingenious automatic contrivance and landed on the draining table, where one man, if it be winter time, plucks the bristles with which at that season of the year it is adorned. Another man, standing on the opposite side of the table, connects the carcass with an endless chain, which lands it against a set of revolving vertical wheels, with flexible broad steel flanges projecting from its outer rim. This machine in a very few seconds scrapes every vestige of hair from the accessible parts of the hide. As the hog emerges from this treatment it is thrown upon a long table, where, from first to last, sixteen men, eight on each side, await its coming. Two of them shave from under the armpits the few hairs which the scraping wheel has been unable to reach. The next man, at one stroke, severs the head nearly from the body, leaving it hanging only by a shred. His assistant meanwhile has cut two slots in the hind legs and thrust a "gambol stick" into the holes thus made. He slips one end of a double hook round this "gambol stick" and slides the other end over the run, and with a gentle shove starts the hog again upon its travels. Ten minutes have sufficed to transform a well fed, contented hog into a headless, hairless carcass. All the time it is running the gauntlet a stream of cold water is continuously pouring down upon the animal, and washing away all traces of the cutting and slashing to which it is subjected. The next man opens the animal and takes out the paunch and intestines, etc., while another removes the leaf fat, subsequently to be used in making "neutral" for oleomargarine, as hereafter explained. A little further along another operator "faces" the hams; that is, with a sharp-pointed knife he traces on the hide the shape of the hams which are eventually to be cut. By this time the hog has journeyed about 25 feet from the scalding vat into which it was first plunged. At this point the head is completely detached. The tongue is taken out, to be canned for lunch purposes, and the head is either singed and made into English brawn, or the cheek meat is cut off and the rest rendered into lard, according to the price which either commodity commands in the market at the time. The carcass is pushed along a little further, and a skilled hand marks a line down the back to guide the chopper. Boys with hooks stretch the hind legs apart, and the chopper, with a meat ax, divides the headless carcass into halves down the middle of the spine. It is then carried on runners to the hanging room, where it is allowed to remain till the last vestige of animal heat has departed, prior to its being taken to the chill room. This is a most necessary and carefully observed precaution, for if the carcass were immediately conveyed to the chill room the cold air would congeal the outer flesh, leaving the animal heat within, and the meat would sour in the curing. (See Plates XIX and XXII).

The chill room is maintained at a temperature of about 36° F. the year round. In warm weather this temperature is obtained in the best regulated packing houses in the same manner as in beef packing, by salt water, refrigerated by the evaporation of ammonia, pumped into pipes encircling the room. In other houses less uniform results are obtained by the use of ice. After remaining in the chill room about forty-eight hours the meat is hauled out by an endless chain and dropped upon the chopping block. There at two strokes each segment of the defunct hog

RUNNING CARCASSES OF HOGS TO COOLING-ROOM, ARMOUR'S SLAUGHTER-HOUSE.

INSPECTING HAMS, ALLERTON'S SLAUGHTER-HOUSE.

is cut into three. The ham is cut off at one stroke, the shoulder at another, and the side is thus left. These are trimmed to the desired shapes and are ready for curing.

Every part of the animal is utilized. The lean-meat trimmings from the hams, shoulders, and sides are made into sausages; the feet are pickled or canned; the ears and other gelatinous parts are converted into glue; the blood, dried and pressed, brings 1½ cents a pound as a fertilizer; the skins of the intestines are cleaned for sausage casings; the bristles and hair are sold; the intestines and salt trimmings and other refuse are tanked for soap grease, and the residuum makes fertilizers.

The methods of curing are as follows:

The first destination of the meats about to be cured is the cellar, a dry flagged chamber, kept at a temperature of about 40° F., and from which all daylight is excluded. Here the hams are assorted according to weight, and sprinkled with saltpeter, salt, and granulated sugar. At the end of ten days they are turned and resprinkled, and left to cure for twenty or thirty days longer. The sides are treated in a similar manner, unless intended for what is technically termed mess pork, in which case they are cut into uniform pieces, packed in barrels in dry salt, and pickle afterwards poured over them.

When the hams, etc., are received in the cellar from the cutting room, they are scraped and cleaned, and any defects in trimming are rectified, and at the same time they are carefully inspected for any signs of taint, or bruise, or other imperfection. Those that are found perfect are taken back to the chill room and put on racks and chilled for at least twenty-four hours. After that they are brought out and packed in tierces in a pickle composed of sirup, sugar, saltpeter, salt, and other ingredients, and are allowed to remain in this pickle in the chill room from sixty to seventy-five days before they are deemed sufficiently cured to be smoked. They are then taken out of the pickle, washed, and taken to the smoke house. Usually this is a 12-inch brick building, three stories high. It is divided into floors by movable racks, which are withdrawn after the hams have been hung upon hooks on rafters provided for that purpose. A fire of hickory or maple wood—the latter regarded as giving the better flavor—is kindled below, the smokehouse is closed, and the hams, etc., are smoked for forty-eight hours. They are then ready for market. No cured meats are sent out that have not undergone at least thirty-five days' pickling—a period of time sufficient to destroy all germ life. The great bulk of the cured meats remain in pickle, or otherwise under vigorous treatment, for a much greater length of time.

Periodical inspections of hams, etc., are made by officers of the Chicago Board of Trade, and it is always optional with purchasers to cause such inspection to be made before delivery. The principal packing houses have repeatedly offered to coöperate in establishing a uniform system of inspection of their meats by the General Government, prior to shipment, and a measure is pending in Congress with that end in view. They conduct their business with the utmost publicity, and permit visitors to enter any part of their establishments to witness the operations in progress. (See Plate XXIII).

CANNED MEATS AND SOUPS.

The canned-meat industry of Chicago has developed into gigantic proportions. The cannery of Armour & Co. has a capacity of putting up in one day 225,000 pounds of corned beef, 50,000 pounds of fresh boiled beef, 10,000 lunch tongues, 4,000 ox tongues, and a multitude of minor products. This firm has been awarded for the past three years in succession the contract of supplying the French Government with canned "boeuf bouilli" for army and navy use. Other establishments have almost equal canning facilities.

Cattle killed for canning are usually well fattened native cows, and Texas and other range cattle, such as are usually ranked in the market as good butchering cattle. Corned beef, after being first salted and cured in the chill room, at a temperature of 38° F., is taken over to the cannery and cooked by steam in hot water. It is then put upon the chopping table and cut up. Hand labor is employed for this purpose because it is necessary to select the parts of the beef that go into the cans, and to throw out the gristle and other unsuitable portions. The best cuts of table beef are selected for canning purposes. This process over, all the rest of the manipulations is done by machinery. The cans are placed in a receiver and are charged from the bottom. A steel plug or plunger presses the beef compactly into the cans. They are then weighed, and any shortage or overplus is rectified. A circular orifice is left in the bottom of the can. Upon this a disk of tin plate, with a small hole in the center, is laid, overlapping the orifice, and firmly soldered around the rim, leaving the little aperture in the middle still open. The cans are next placed in a steam bath for about thirty minutes, which creates a vacuum. As soon as the air is thus expelled from them, the remaining opening is quickly soldered, and the can is then air-tight, or should be so. Each can is tested by an expert, who ascertains by sounding if there is any defect. If so it is thrown out, but if found perfect the cans are run through steam and washed in hot water to remove all particles of grease from the outside, and are then plunged into a bath of cold water to collapse them. The only remaining process is the lacquering and labelling. This is done by girls and women.

Chip beef is pickled for thirty days, in the same way as corned beef. It is afterwards smoked for forty-eight hours, like hams, and hung in the drying room for ten days or two weeks, where it dries in the natural air. It is then sliced by machinery and placed in boxes for market.

Extract of beef is prepared in vacuum pans, by a process which extracts from the material only its nutritive properties. Twenty-one pounds of beef, treated by this process, yield one pound of thick extract. Twelve pounds of beef yield one pound of liquid extract. One ounce of thick extract will bear the addition of forty ounces of water, and will then form a rich soup. One ounce of liquid extract will bear ten ounces of water. Prime cuts of beef are used for this purpose, of necessity, because the process requires that the material employed shall contain as little gelatinous matter as possible. As prepared in the Chicago canneries the extract of beef is a light chocolate color. It has neither the dark hue, the burnt taste, nor the peculiar odor which pertain to extracts prepared in South and Central America.

Ox and other tongues are cured in the chill room; are carefully examined for blemishes, and such as are found perfect are skinned and placed in cans, one ox tongue to a can, and sorted according to sizes. The cans are soldered, lacquered, and labeled as with corned beef.

In the preparation of soups, etc., skilled *chefs* are employed, and the soups are made and cooked as they would be in a first-class hotel or restaurant, except that they are not cooked to a finish, a margin being left for the steaming process they have to undergo in canning and for the warming over to which they will be subjected before being brought to the table. For chicken soup chickens are purchased, ready dressed, in the country, many thousand pounds at a time. They are partly cooked; the breasts, legs, and wings are cut up and packed in cans, in the proportion of 8 ounces of solid meat to a two-pound can. The rest of the chicken is boiled down into "stock" and added to the meat until the can is filled. It is then placed in a steam bath and soldered as other goods.

All the principal canning establishments make their own cans. They use the best steel plate tin, the best solder, and invariably solder from the outside, thus avoiding all danger of so called "can poisoning."

OLEO OIL.

The product known to commerce as oleo oil is obtained from the fat of beef cattle. Immediately after the animal is slaughtered the caul or abdominal fat is removed, carefully washed, and passed through a series of vats of cold water until the animal heat is entirely eliminated. The fat is then chopped by machinery and dumped into vats of broken ice, where it is chilled. It is fed from these vats, by an endless chain, into a machine called the "hasher," which, revolving at a high rate of speed, completely macerates it, so as to allow of the separation of the fiber from the fat at a temperature considerably below boiling point. From the hasher it passes through sieves directly into the refining tanks. These are kettles of from 3,000 to 5,000 pounds capacity, fitted with steam jackets and revolving blades or stirrers. Steam is turned on until a temperature of about 150° F. (= to 65° Celsius) is reached. The fat dissolves in this heat, and, when the revolving blades are stopped, the scraps fall to the bottom, and the molten fat is drawn off by a siphon into the graining or seeding vats below, where it is allowed to gradually solidify. In about 48 hours it forms a partially solid granulated substance, of a pale yellow color, without distinguishing taste or odor. It is then ladled into stout linen cloths, and spread upon metal plates in a powerful screw press, and subjected to a pressure of about 150 pounds to the square inch. The oil thus expressed is oleo oil. The fibrous matter left in the cloth in the press is white in color, brittle to the touch, and slighly waxy to the taste. It is called oleo stearin, and is used in the manufacture of compound lard.

There are three grades of oleo oil—No. 1, No. 2, and No. 3. The difference consists in delicacy of flavor and fineness of granulation. No. 1 is made exclusively of selected caul fat. Nos. 2 and 3 are made by a similar process but with an admixture of kidney and other fats which give a coarser grain to the oil and impart a slight flavor which is entirely absent from oleo No. 1.

Nearly 40,000,000 pounds of oleo oil were shipped from Chicago to Holland during the year 1888.

OLEOMARGARINE.

Strictly speaking, oleomargarine, as formerly known to the trade, has ceased to be an article of general manufacture in the United States. It was composed of oleo oil, churned with milk and cream, and sometimes with a small quantity of creamery butter, the whole being salted and colored in the same manner as butter. The product which is now chiefly manufactured and sold under that designation is known to the trade as butterine. It is composed of similar materials to those of oleomargarine, but in different proportions, and with the addition of "neutral," a substance derived from the leaf fat of hogs.

The laws of the United States require all food products made in semblance of butter, and not made exclusively of milk or cream, to be branded and labeled "oleomargarine." Hence that term is applied to all such products. A tax of two cents per pound is imposed upon the article, and those who manufacture it are required to take out licenses and to conduct their business under the supervision of officers of the Government. Dealers in the article are also required to pay licenses and to submit their books to the inspection of the proper officers of the United States. The total amount withdrawn from factories tax-paid during the fiscal year 1888 was 32,489,165 pounds, of which 1,686,198 pounds were exported leaving a balance of over 30,000,000 pounds for home consumption.

The leading ingredients in the so-called oleomargarine, as already stated, are oleo oil and neutral. The manufacture of neutral lard is conducted by essentially the same machinery and at about the same temperature as the manufacture of oleo oil. Only the leaf fat of freshly killed hogs is used, and (as also in the case of the beef

fat) scrupulous care is taken that every piece used shall be without taint of any kind. The neutral is not pressed to extract the stearin. As it falls from the melting kettles into tanks of strong iced brine placed to receive it, it crystallizes into flakes white as snow, and absolutely without perceptible smell or taste. It remains in these vats about twenty-four hours, and is then removed and placed on shelves to drain, after which it is ready for use. The object of the process is to obtain a neutral fat melting at butter temperature.

Most oleomargarine factories are buildings four stories in height. On the upper floor the oleo oil and neutral are melted in separate kettles at a temperature of about 90 degrees. The proportion of milk and cream which enters into the product is from 10 to 20 per cent. One of the firms largely engaged in this manufacture in Chicago (Friedland & Swift) have in their establishment a well-appointed dairy, heated by steam pipes to the required temperature, in which pans of cream and milk are set out to sour, and are afterwards separately churned into butter precisely as in a creamery dairy. The more usual process is for the charge of cream and milk, slightly soured, to be first run into a steam-jacketed churn, fitted with steam paddles, which are agitated until butter begins to form. Then the oleo oil is let down and stirred in by the agitators. After it has been thoroughly mixed the neutral lard is added, and lastly a small quantity of best quality of creamery butter, and sufficient anotto (the harmless vegetable coloring used in butter making) to give the required tint. The temperature during the churning process is carefully regulated, beginning at 85 and running up to 105 degrees, and the time occupied varies from twenty-five minutes to an hour and a half. Some manufacturers, in order to soften the granular consistency of the oleo oil, and to give a better texture to the whole product in cold weather, add a certain proportion of refined cottonseed salad oil. In the higher grades of oleomargarine this result is attained by decreasing the proportion of oleo oil, and adding more creamery butter.

When all the contents of the churn have been thoroughly amalgamated they are discharged into vats of chopped ice in the floor below. The object of this sudden process of cooling is to give a fine grain to the product. The oleomargarine is allowed to remain in these cooling vats from thirty to forty-eight hours, until completely solidified. It is then taken out and placed on wooden trays to drain, and afterwards is salted and thoroughly worked by mechanical rollers, in the same manner as butter, until all the buttermilk and water have been pressed out. It is then cut and weighed and molded into the required shapes, which vary according to the market for which it is intended. After that it is placed on racks in the cooling room, at a temperature of about 38 degrees, and there it stays until packed in stamped tubs and boxes of sizes regulated by the Government, when it is ready for shipment.

Scrupulous cleanliness is observed in every process of the manufacture. This is more than a matter of choice; it is a necessity. Any deviation from it would be perceptible in the manufactured article. The kettles, tubs, tanks, molding boards, and even the floors of the factories are constantly scalded, steamed, and scoured, and kept as clean as the dairy rooms of a model farm.

LARD.

There are three grades of lard:

(1) Prime steam lard. This is the leaf fat of hogs, and the selected fat trimmings, cooked in a closed tank, by wet steam, at a pressure of from 35 to 40 pounds for from twelve to sixteen hours, after which the tank is allowed to settle and the lard is drawn off.

(2) Pure kettle-rendered lard. This consists of the fatbacks and other trimmings of hogs, rendered in an open kettle, and agitated while cooking to prevent burning.

(3) Refined lard. This is a compound production. It includes, besides a certain proportion of the higher grades of hog fats, the lard stearin left in the extracting of lard oil from leaf lard, the settlings and scrapings from the kettles from which the neutral lard is made, and all available fat tissues of the hog, to which are added the beef stearin obtained in the manufacture of oleo oil, and a certain quantity of double refined cotton-seed salad oil. The preparation of this product involves the employment of a somewhat complicated arrangement of steam jackets, hot-air agitators, settling kettles, filters, and other machinery.

The completed product of the third grade is sold for what it is—a compound lard; but the first two grades are inspected by the board of trade, and branded with a certificate of their purity before being put upon the market.

TRICHINIASIS AND HOG CHOLERA.

It only remains to speak of the questions whether the parasites found in trichinous hogs can be transmitted in a living state in the pork exported to European countries by the United States, and whether the flesh of animals dying of hog cholera or swine plague is ever converted into a food product.

On these points official investigations of an exhaustive character have been had. As a preliminary step the Department of State, in March, 1881, prosecuted an examination into the various phases of the pork industry in the Western States, covering all possible causes which could operate to render the products dangerous to health. The President of the United States, October 3, 1883, appointed a commission of impartial scientists and representatives of the New York Chamber of Commerce and the Chicago Board of Trade, instructing them "to make a searching examination on the spot of all the conditions of the hog-raising and pork-packing industries of the United States, and to follow by the most practical examination the course of this food staple from the fields and farms to the wharf where it is shipped, or to the shop where it is exposed for domestic consumption." The results of these investigations were communicated to Congress by the Executive, accompanied by voluminous diplomatic correspondence and other information bearing on the subject.* From the official data thus presented, which remain uncontroverted to this day, these broad deductions and statements of fact are derived:

It is conceded that the *Trichina spiralis* is found in American swine, though the proportion of animals thus infested appears to be less than in the countries of Europe. No definite conclusion as to the manner in which swine become affected with the disease has been reached. It is established that hogs may present every outward appearance of health and yet microscopical examination may show the presence of trichinæ.

In the human subject the disease is developed from eating freshly killed pork, either raw or only partially cooked. The virulence of the disease diminishes with the time elapsing between the killing of the animal and the consumption of the flesh.

No case of trichiniasis has ever occurred in any European country as the result of eating cooked American pork, whether cured or fresh.

No authentic case of trichiniasis has been clearly established in any European country resulting from the eating of cured American swine products as prepared in the export packing houses, whether the meat has been eaten raw or cooked.

The prominent cases of trichianiasis occurring in foreign countries and ascribed to American pork have in every instance on investigation been ascertained to be the result of eating home-killed swine, or the products of other countries than the United States.

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*Ex. Doc. No. 209, Forty-seventh Congress, first session; Senate Report No. 345, Forty-eighth Congress, first session, embracing Ex. Doc. No. 70, Forty-eighth Congress, first session.

The trichina can not long survive in well-salted meat. If transmitted in its encysted state abroad in American pork the cyst of the parasite is its tomb. The testimony of Prof. Virchow is that American trichinæ lose their injurious properties through smoking, salting, pickling, and especially through the long journey, and that he has not been able to find one case of trichinosis caused by American bacon or ham.*

No case of trichiniasis has ever arisen from eating American canned meats, because such meats are always subjected to a temperature above boiling point, in some instances as high as 240° F.=115° C.

No death from trichiniasis has ever occurred in the United States Army or Navy, though packed pork forms part of the daily food in both branches of the service. No case of trichiniasis has ever been brought under treatment in the United States Marine-Hospital Service.

Though the annual consumption of hog products in the United States amounts to over 4,200,000,000 pounds, no city or State, in the exercise of its police powers, has found it necessary to attempt to restrain the use of American pork meats on sanitary grounds, or for any other reason. Fatal cases of trichiniasis are extremely rare in the United States, and almost invariably occur among foreign-born residents, and from eating uncooked the flesh of improperly fed swine, such as would be immediately rejected if offered for sale to the packing houses which kill and cure hogs for the foreign market.

In respect to the disease known as hog cholera, or swine plague, the facts disclosed by the official reports above referred to conclusively establish:

That the disease attacks most frequently young pigs before they arrive at marketable age.

That the character of the disease is such that decomposition sets in before death, and the use of the carcass, or any part of it, for human food is an impossibility.

That in no event is the disease communicable to human beings.

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* Prof. Virchow, as quoted in the Magdeburger Zeitung, January 12, 1883. Senate Report No. 345, Forty-eighth Congress, first session, p. 117.

CHAPTER XII.

CATTLE AND SWINE REARING AND FEEDING IN THE UNITED STATES.

By GEORGE E. MORROW.

For many years rearing and feeding cattle and swine have been important parts of the work of most of the farmers of the United States. There has been a good home and fair foreign demand for these animals or their products. In no other country is the consumption of meats so great in proportion to population, and this chiefly of beef and pork rather than of mutton. Milk and butter have also long been used freely; cheese to a less notable degree.

As what are now the central Western States were occupied, farmers found in the fertile soils and climate, favorable for the production of forage grasses and cereals, more especially maize, strong inducements to give large attention to cattle-rearing. In a peculiar sense was this true of the settlers on or near the vast prairies covered with a luxuriant coat of fairly nutritious grasses, and with a soil not only possessing great stores of readily available plant food but capable of being brought into cultivation with a minimum of labor and cost. More recently still more extended areas of lands in the farther West, most of it unsuitable, except for grazing purposes, were stocked within a decade with millions of cattle.

The obvious superior fitness of animals and animal products over grains for transportation to distant markets has had much influence in more and more widely extending stock-farming in most parts of the country. While this branch of agriculture, taken as a whole or considered with reference to either of its divisions—the production of cattle, horses, swine, or sheep—has had alternations of great prosperity and of marked depression, it is clearly true that the average profits have been fairly satisfactory and the business has received the attention of many of the most intelligent and progressive farmers of the country.

The number of domestic animals in the country, or the number and distribution of those of any one class, can not be given with accuracy. The estimates of the statistician of the National Department of Agriculture include only the numbers to be found on the farms and ranches of the country, making no estimates of large numbers kept in cities and villages.

There were probably at the opening of the year 1889 about 50,000,000 cattle on the farms and ranches of the country. The official estimates give the number on January 1, 1888, as 49,234,777, classified as milch cows, 14,856,414; oxen and all other cattle, 34,378,363. This showed a total increase of 1,200,944 in the year 1887 as compared with an increase of 2,523,203 in 1886. It is believed the increase in numbers in 1888 was very slight.

It is exceptional not to find cattle on the average farm in any part of the country, and while there are striking differences in the extent to which cattle-rearing is pursued in different parts of the country, it is difficult to satisfactorily name those portions most properly to be called cattle-rearing sections. A comparison of numbers by States is misleading, owing to the great difference in the size of the States and the difference in the average value of the animals. Thus, Texas has about one-seventh of all the cattle in the country, but the number in proportion to total land area is slightly less than in the State of Rhode Island, with an insignificant total of 36,037 head of cattle, and the value of the cattle of Iowa is almost as great as those of Texas, although the number is not half so great.

In general it may be said the highest average value of cattle is in the northern Atlantic States, but, excepting New York and Pennsylvania, none of these have large numbers, and all of them import considerable numbers of beef cattle or meats. The more northern States have the largest number and most valuable dairy cows. The south Atlantic and Gulf States have comparatively small numbers of cattle of inferior quality.

The regions from which cattle or dressed beef are largely exported to other States or to other countries are two: A group of seven States in the central West—Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, and Nebraska, these also being known as the chief corn export States, and a group of two States and three Territories in the farther West—Texas, Colorado, New Mexico, Montana, and Wyoming. These two groups have more than half of all the cattle in the country, and about two-thirds of all, aside from the milch cows. It is to be kept in mind that in the second group only a small percentage of the cows are classed as milch cows, as they are not used for dairy purposes, being suckled by their calves.

This classification is somewhat arbitrary, and does injustice to some States noteworthy for number or excellence of cattle, as New York, with approximately, 2,400,000 head, of which over 1,500,000 are milch cows; Pennsylvania, with about 1,800,000 head.

The accompanying table from the Report of the Commissioner of Agriculture gives estimated number and value of the cattle in each State and Territory January 1, 1888:

Estimated number and value of cattle on farms in United States, January 1, 1889.

[From the report of the Statistician United States Department of Agriculture]

States and Territories.	Milch cows.		Oxen and other cattle.	
	Number.	Value.	Number.	Value.
Maine	167,507	$4,857,703	185,160	$5,093,108
New Hampshire	99;021	3,020,141	141,670	4,241,11 .
Vermont	225,552	6,473,342	180,362	5,059,693
Massachusetts	180,319	6,161,500	105,023	2,990,105
Rhode Island	22,883	818,067	13,154	424,463
Connecticut	127,153	4,286,328	109,926	3,434,104
New York	1,540,053	46,971,617	851,128	27,164,603
New Jersey	178,114	6,397,855	68,541	2,217,467
Pennsylvania	929,371	26,580,011	867,059	22,620,106
Delaware	28,683	860,490	27,137	759,835
Maryland	135,021	3,814,343	138,182	3,340,798
Virginia	257,793	5,54 ',550	423,761	7,360,725
North Carolina	243,758	3,900,128	419,383	4,607,133
South Carolina	146,195	2,777 705	212,521	2,651,835
Georgia	337,603	5,739,251	598,656	6,588,930
Florida	52,822	862,055	576,912	4,941,078
Alabama	296,787	4,570,520	445,139	4,18',825
Mississippi	285,904	4,445,807	428,909	4,064,000
Louisiana	162,649	2,651,179	270,816	3,069,187
Texas	772,716	10,972,567	6,336,504	63,077,993
Arkansas	304,404	4,453,431	469,057	4,603,415
Tennessee	339,572	6,706,547	461,239	5,815,073
West Virginia	171,273	4,122,541	280,892	5,196,913
Kentucky	313,953	7,629,058	529,018	11,237,676
Ohio	783,481	22,877,645	967,540	24,766,690

Estimated number and value of cattle on farms, etc.—Continued.

States and Territories.	Milch cows.		Oxen and other cattle.	
	Number.	Value.	Number.	Value.
Michigan	437,303	$12,681,787	511,406	$12,865,948
Indiana	556,961	15,455,668	894,344	20,066,941
Illinois	937,476	24,843,114	1,485,754	33,0[illegible]9,792
Wisconsin	548,222	13,064,130	640,752	13,438,163
Minnesota	433,966	10,306,693	489,886	9,[illegible]74,076
Iowa	1,255,432	29,251,566	2,095,253	42,633,795
Missouri	737,259	14,929,495	1,429,453	26,077,367
Kansas	640,081	14,344,215	1,583,915	32,2[illegible]1,946
Nebraska	357,202	9,108,651	1,079,646	22,763,690
California	250,773	8,275,509	692,267	14,194,447
Oregon	78,997	2,338,311	598,218	12,172,122
Nevada	18,037	631,295	323,400	5,819,648
Colorado	62,023	2,345,086	1,049,353	20,918,327
Arizona	16,298	606,286	420,000	7,560,000
Dakota	223,418	4,841,468	767,809	16,687,171
Idaho	26,458	705,635	424,316	7,955,925
Montana	31,132	884,149	934,500	17,948,007
New Mexico	19,394	460,608	1,257,597	18,911,121
Utah	49,878	1,259,420	435,000	7,292,733
Washington	65,523	2,181,916	300,676	7,060,177
Wyoming	6,994	244,790	1,230,192	23,504,663
Indian Territory	....	....	626,937	9,090,587
Total	14,856,414	366,252,173	34,378,363	611,750,520

The marked differences in value of the cattle in different parts of the country results from several causes. Climate and soil, with consequent cheapness or dearness of cattle foods, have had much influence, but much of the present variation in quality is dependent upon differences in the foundation stock and on the interest taken in improvement of this stock. The cattle brought to the more northern States were generally from Great Britain, those in the most southern and southwestern regions came largely from Spain. The former were of higher average merit and have had better care and more attention to systematic improvement than have the latter, more especially until within quite recent years.

It is a remarkable fact that there is no generally recognized breed of improved cattle which has had its origin in the United States. The common or misnamed "native" cattle of different sections often have such distinctive characteristics as to entitle them to be classed as distinct breeds, but they are not of high merit, unless, indeed, in adaptation to local conditions, which are often very unfavorable.

Coupled with better care and wiser selection of breeding animals from the stock on hand, great attention has been given, for the last fifty or sixty years to the importation and subsequent breeding of pure-bred cattle of the most prized breeds of Great Britain and, in much less degree, to those of a few breeds from western continental Europe. Of the breeds so introduced may be named: Ayrshire, Devon, Galloway, Hereford, Holstein-Friesian or Holland, Jersey, Polled Angus or Aberdeen, Red Polled or Norfolk and Suffolk Polled, Short Horn or Durham, Sussex, and a very few Swiss, West Highland, Kerry, Normandy cattle, and even a few from India and China.

Of these breeds the Short Horn has had by far the most influence in improving the cattle of the country, especially for beef production. Among the first to be introduced and kept pure, it soon gained wide popularity and is still the most widely distributed and by far the most numerous of the improved breeds of the country. More than 90,000 pure-bred bulls of this breed have had their pedigrees recorded in the American Short Horn Herd Book, about 40,000 of these within the last five years. A much larger number of pure-bred or "high-grade" bulls of the breed have been used, without public record of pedigree. Much attention was formerly given to breeding thoroughbred Short Horns in the more eastern States, but now the largest number of herds are to be found in the group of seven States

previously named and in Kentucky, Michigan, Wisconsin, and Minnesota. The large size, early maturity, fine beef form, good feeding quality, quiet disposition, attractive colors of this breed, together with a good degree of merit as dairy cattle, when attention is paid to the development of the milk-giving habit, have admirably adapted this breed for much of the chief beef-making region of the country. It has suffered from over-attention to certain fashions in breeding, as undue estimate of the red color, and over-appreciation of the value of certain families, with absurd under-appreciation of other families, but the good it has done has been incalculable, and it retains a first place in the estimate of a large number of the best beef producers of the country.

The second in number of the breeds best adapted for beef making is the Hereford. Although imported to the country more than sixty years ago, this breed attracted little general attention until within the last fifteen years, although it has always had a few enthusiastic admirers. Owing, in large part, to the skillful and persistent efforts of a few breeders the Herefords, with remarkable rapidity, became a popular breed over nearly all the region in which the Short Horns had long been without a serious rival. Men of wealth, enterprise, and intelligence interested themselves in the breed; hundreds of animals were imported in each of several successive years. They were well shown at the leading agricultural and fat-stock shows and met with much favor. Nearly equaling the Short Horn in average size, fully as early in maturity, uniform and attractive in color, with a longer and thicker coat of hair, and every appearance of great hardiness, usually short-legged, with deep, compact bodies, admittedly of unusual excellence as grazing beasts, they became the favorite breed of many, and were especially popular with many seeking to improve the cattle on the great ranches of the far West.

The third in number of the distinctive beef breeds is the Polled Aberdeen-Angus. The rise of this breed in public esteem was almost or quite as remarkable as in the case of the Herefords. It had to overcome a very considerable prejudice among American cattle growers against the black color, but was helped on the other hand by its lack of horns, a widespread feeling that horns are a serious disadvantage to cattle, especially to those to be fed outside stables, having been developed in recent years. Unsurpassed in compactness of body and lightness of offal, and in symmetry and finish of the best specimens the marked success of the breed at the great Paris Exposition of 1878 and at prominent British shows was followed by striking success in American show yards. With large importations and skillful breeding by a considerable number of men of large wealth and business sagacity the merits of the breed were presented with a degree of skill probably not equalled in the case of any other breed, and the Angus won and retains a high place in the esteem of the best American cattle-breeders. With this breed may be mentioned the Galloway, resembling the Angus in color, in lack of horns, and in form so closely that the average cattleman distinguishes them with difficulty. With the persistent claim in its behalf of superior hardiness, this breed has met with a good degree of favor.

The Devon was early introduced into the country, has always been the favorite with some and has merit freely conceded by all—a beautiful red color, often excellent form, much hardiness and activity, producing beef of fine quality—and yet has never been widely popular. The one chief objection has been lack of sufficient size. There is no instance in which any breed of animals chiefly designed for meat production has secured, or at least retained widespread popularity, unless it was above medium size for its class. In the last few years the Sussex, a breed which in color and in some other characteristics may be popularly described, as a larger Devon, has been imported and bred in small numbers and have attracted much favorable comment, but as yet the breed has had no perceptible effect on the cattle of the country. Something like this is also true of the Red Polled breed from Nor-

folk and Suffolk, England, of which there are one to two thousand in the country, and which breed is meeting favor as possessing good merit for both beef and milk production, with a popular color and absence of horns.

The Ayrshire, a favorite with some dairymen, has never been largely bred in the chief beef-making regions.

The large black and white cattle of Holland, now known in the United States as Holstein-Friesians, have been largely imported and bred, have won high favor in dairy regions, and have had some influence on the beef production of the country. Often a little coarse in form, the good size and rapid growth of the calves has given the breed favor with a considerable number of farmers who combine dairying with beef-making.

The Jersey is undoubtedly only second to the Short Horn in number in the country and has been exceedingly popular among butter-making dairymen. Naturally it has made little headway in the great beef-making regions, and cross-bred calves produced by the use of Jersey bulls in dairy herds have, as a rule, not been kept to maturity. Except that they have not been imported or bred in equally large numbers, the same comment may be made on the Guernseys.

Of other breeds so few have been imported that they are objects of curiosity to most cattlemen, rather than serious factors in improving or injuring the beef product of the country.

The Texas cattle should be mentioned, not because of merit but because of their large numbers, striking peculiarities and marked influence on the beef product of the country, especially in former years. The descendants of the Spanish cattle brought to the West Indies and Mexico, they bred in enormous numbers on the plains of Texas, retaining many of their characteristics, but becoming lighter in body and flesh, longer and fleeter of limb, wider in spread of horn, wilder in disposition, and slower in coming to maturity. When well fattened their flesh was of good quality, but they were unprofitable except under such conditions as produced the breed. Of recent years large numbers of bulls of the improved breeds have been used in Texas and other southwestern districts, and the quality of the cattle has been perceptibly improved. The typical Texas steer will probably become a thing of the past within a few years.

The influence of cattle of improved blood has been very great, but the large majority of the cattle are yet chiefly of common or unimproved blood. There is no means of determining exact percentages, but it is believed there is no State in which one-half of the cattle can be properly classed as even "half bred." The smallest percentage of improvement is to be found in the extreme West and South, the largest, so far a beef production is concerned, in the central Western States.

The breeders of pure-bred cattle rank among the most intelligent and progressive of American farmers. To their efforts much of the improvement in the cattle of the country is due. It is also true that many of them have found the business very profitable. There have been great fluctuations in value, times of depression, followed by years characterized by ready sales at high prices. Unfortunately, there has been a time of unusually depressed cattle markets for two or three years past. The year 1888 was one of the least satisfactory to either breeders or feeders that has been known for many years. Some of the causes are easily seen. Among the chief may be named the remarkable development of the cattle rearing on the far Western plains. Under the conditions found there of practically free land, with a climate such that the sparse grass dried where it grew and left passable food during the winter, it was possible to produce moderately good cattle at very low cost. Vast sums were invested in these Western cattle ranches, and the supplies from them became enormously large. The demand for cattle with which to stock these ranches gave a stimulus to cattle rearing in the central Western States and, in some degree, reduced the supplies sent to the ordinary markets. After a few years the proprie-

tors of many of these ranches found that the losses from severe winters and other causes caused a net loss instead of the expected profit. This caused a disposition to reduce the numbers by increasing the shipments to markets. The demand for breeding stock for the ranches largely ceased. The year 1887 was characterized by severe drought over a large area and a decreased corn crop. Increased shipments to market, often of only partially fattened cattle, naturally followed. Lower and lower prices followed, with increasing discouragement on the part of producers, and increasingly large shipments, often of calves or breeding females.

The receipts of cattle at Chicago in 1888 were about 230,000 in excess of those in any previous year. They were 2,611,543, aside from about 100,000 calves. This is an average of 50,000 for each week. In one week over 70,000 were received, with over 20,000 in one day. The year 1889 opens with almost unprecedentedly low prices for both fat and breeding cattle. It is believed, however, that a reaction is not far distant, and that fairly remunerative prices will again prevail. There is no reason to believe that cattle rearing is to cease to be a leading industry among the farmers of the United States.

In a country of such vast extent there is great variation in the systems of management. Those of most general interest are the ones pursued in the regions which furnish the largest numbers of cattle or beef for the great markets of the country. These are chiefly the two regions already described as the great maize and grass producing States in the central West and the grazing lands of the still farther West.

In contrast with the best systems in older countries, or even those most favored in the older settled portions of the United States, the cattle rearing and feeding of these regions seem rude, often wasteful of land and food. The one thing most carefully husbanded is human labor. Judged by adaptation to the circumstances, or by the quality of much of the product, the systems pursued in the West are good.

There are many farms on which cattle rearing is the leading feature. On these the rule is to allow the calves to suckle the cows, often allowing them to run together in the pastures during the summer and early autumn months, weaning the calves when they are six or seven months old. This is the almost universal custom on the great ranches, except that on these the cows are often allowed to suckle the calves as long as they will. After weaning, the calves in the great grain-growing regions are liberally fed, most commonly with shelled corn and oats, with hay, straw, and corn fodder during the winter, the bull calves, of course, being castrated at time of weaning or before. As yearlings the cattle are usually simply allowed the range of good pastures, without grain, although the practice of summer grain feeding is becoming more common. It is still the rule that the young steers are kept through the second winter as cheaply as is consistent with maintaining fair condition, allowing them to run in the fields from which the corn has been husked, giving them straw or corn fodder and some hay and grain. In the more southern portion of the region in question much is made of winter pasturages. It frequently happens that the cattle can get most of their food throughout the winter from pastures which have been kept in reserve for them. In the more northern regions less reliance can be had on winter pasturage, and more attention is given to sheltering the cattle, by means of sheds, etc. Even in States in which the weather is at times quite cold, only a small proportion of the steers are kept in stables. Shelter belts of trees planted for the purpose, or bits of natural forests, are frequented by the cattle during storms. Where the numbers are smaller they are allowed to have free access to stacks of straw, utilized both for food and shelter.

Not infrequently the steers are allowed to get their food from the pastures alone, but an increasing number of steers is now fattened when they are two years old. If this is purposed, many good cattlemen will begin liberal grain feeding in the late winter, continuing this after the cattle are put on the grass and until a satisfactory price is secured, sometimes giving practically all the grain the steers will eat for a

year or more. The chief food is Indian corn, either in the ear or shelled, fed in troughs in the pastures or in the yards in winter. It is a common practice, however, in winter, to feed the stalks, with the ears, either in large racks made for the purpose or, wasteful as the practice seems, scattering the bundles of stalks over the fields. A few years since it was a more familiar sight than now, on the prairies of Illinois or Iowa, to find droves of a hundred or more fine beeves in large grass fields, scattered over which would be seen large troughs, into which there would be daily thrown wagonloads of ear corn, or, in the winter, great loads of "shocked corn," with about an equal number of hogs, fattening without any direct attention.

In 1888 there died, at his home in central Illinois, Mr. John Gillette, the most notable producer of fine beef cattle on a large scale in the United States. He had accumulated by his own exertion a tract of land nearly 20,000 acres in extent, on which there could be found 2,000 or 3,000 cattle of all ages. He kept several hundred high-grade Short Horn cows, rearing the calves and annually buying hundreds of steers. Within the last ten years he had changed his plans so far as to usually fatten his steers at two years old, instead of keeping them until they were four or five years old, but to the last he adhered to this simple system of outdoor feeding, and without stabling his cattle. That his cattle were of the first rank was abundantly demonstrated, but many thought that the increasing value of his lands and the higher prices for corn had so changed the conditions that greater profit would have been secured from systems more careful of the food used. He was the most marked instance of success in a system practiced by hundreds.

There are many thousands of farms in the great cattle-growing region, farms of more moderate extent, on which cattle are not the chief product. Thus there may be ten or twenty cows. In many cases these are milked, butter made, and the calves reared on the skimmed milk. In many other cases, where the cows suckle their calves, a second calf is purchased and reared after the first is weaned. The calves are fed grain or meal as soon as they will eat it. Among farmers of this class, who make butter making somewhat prominent, having the calves dropped in the autumn rather than in the spring is frequently preferred, not only because winter dairying is more profitable, but because it is believed the calves do better, as they are well grown when put on the pastures in the spring and come to the second winter better fitted for it than does the spring-dropped calf to its first winter. Partly because he has a smaller number, such a farmer as we now have in mind more frequently provides shelter in winter for all his cattle. Frequently he buys from neighbors, from regions in which corn is less abundant, steers one or two years old to fatten with those reared on his own farm.

There are a few methods in which beef is produced at lower cost, where grain is used at all freely, than by many such farmers who buy yearling or two-year-old steers at the opening of winter, keep them through the winter on coarse and low-priced food, give them abundant grass the next summer, and, as the Indian corn begins to mature, about September 1, commence feeding this liberally, at first cutting the stalks, which are readily eaten, later pulling the ears from the stalks without removing the husks, and still later feeding the husked ear. Good steers will frequently add 250 to 275 pounds, to their weight in three months of this feeding on the grass in pleasant autumn weather, often adding one cent per pound to their value. The one chief disadvantage to this method is that the cattle go to the markets at a time when these are especially crowded with the grass-fattened cattle from the plains, with consequent lower prices.

There is a growing appreciation of the gain from more early maturity in cattle, and the average age at which beeves are sent to market has been steadily reduced of recent years. But it is still true that the percentage of yearlings slaughtered is small. There is a widespread belief that from thirty to thirty-six months old is the more profitable age, under generally existing conditions.

As was to have been expected, with the growing density of population, advance in the price of farm lands and of feeding stuffs, there is a rapidly increasing number of cattle reared and fattened under careful management in every regard. This is more especially true in the eastern and northern portions of the beef-making regions. Many thousands of beeves are annually stall-fed in comfortable stables, and fed on carefully prepared rations, in which, while Indian corn usually is a chief element, oats, bran, and oil cake are freely used. Thousands of cattle are annually fed on the by-products from distilleries, etc. Aside from such establishments, the practice of feeding cooked foods is exceptional. Grinding various grains and feeding them with chaffed hay or straw is a quite common practice. Maize ensilage is now used on thousands of farms, most commonly being fed to dairy cows, but an increasing number are feeding this to beef cattle, and with satisfactory results.

There has been a considerable change in the market demands of recent years. Extremely large cattle are less common than formerly, although the average weight of the cattle sent to the leading markets is doubtless greater than formerly. The highest prices are now often secured for young, smooth, well-fattened steers weighing not more than 1,350 to 1,450 pounds. While large numbers of inferior cattle are still sent to the great markets, the local butchers consume a great percentage of these. It is not an uncommon remark that residents in the country and smaller towns in sections from which thousands of high-class beeves go to the great markets, rarely have an opportunity of eating beef from such cattle.

The cattle shown at the fat-stock shows annually held for several years past at Chicago may be taken as well representing the highest excellence yet reached by cattle-feeders in the United States. The average of steers of the leading breeds exhibited at this show for eight successive years was, in round numbers, 1,950 pounds for three years old, 1,500 pounds for two years old, and 1,303 pounds for yearlings. The maximum weight, in many cases, were largely in excess of these averages. At the show held in November, 1888, weights of 2,080 pounds for two years old, 1,600 pounds for yearlings, and 1,070 for steers under one year old were recorded.

The story of the methods of cattle management on the great ranches of the Western plains has often been told. With many points of difference, the great ranch region extending from Texas on the south to the British possessions on the north is characterized by a scanty rainfall during the summer and autumn. The wild grasses do not make a great growth at best, and when the drought comes on they dry into hay, upon which the cattle can live during the winter. The great mass of these lands are still owned by the Government, the light rainfall making them unsuited for agricultural purposes. On these vast areas of hundreds of thousands of square miles, herds, often of half wild cattle, are bred and reared, often without any other food than the natural grasses, and with little attention, save at the annual "round-ups," at which the cattle grazing over an area as large as some of the smaller States of the Union are collected, separated according to their brands, the calves branded, the males castrated, and the cattle best fitted for market put in separate droves.

During severe weather the losses of these cattle are sometimes very great. Of recent years it is coming to be recognized that there must be considerable modifications of the system. The scanty pasturage, and the fact that water for the cattle is sometimes only found at points a number of miles from each other, make it difficult or impossible to conduct the business on a small scale, and are serious obstacles to confining the herds within inclosed fields. It is found practicable, in some regions, to cut sufficient hay for use during severe storms in the winter, but even this is not possible in many parts of the range country. The good size, marked vigor and healthfulness, and very fair degree of flesh carried by cattle which have no other food than wild grasses since weaning time, is a surprise to

those not familiar with the facts. In the great cattle markets, the better quality of the range cattle are preferred by buyers to the grass-fattened cattle from farms.

Some years since many young cattle were driven from Texas to the more northern ranges to be matured, but more recently the supply of cattle bred there has been sufficiently large. On the part of many of the cattle-owners commendable efforts have been made to improve the quality of the herds by the purchase of large numbers of pure-bred or high-grade bulls. The change in the conditions of life was so great with these that many of them died, but there has already been a noticeable improvement. The Hereford, Shorthorn, Angus, and Galloway breeds have been chiefly used for this purpose. It is undoubtedly true that many range men prefer a bull with comparatively little of the blood of the improved breeds, believing that better-bred animals have less of hardiness and are less fitted to withstand the privations unavoidable at times.

It is probable there will be very considerable changes in the ranching system in the near future. As hitherto conducted it has not proved permanently profitable in very many cases. Something of a reduction of the total numbers kept, with closer supervision, probably the utilization of the regions which can be irrigated for the production of hay, millet, etc., are lines of change believed probable by many.

An interesting feature, which has become common in the last few years, is the shipment of large numbers of cattle from the ranges for fattening in the regions in which Indian corn is most cheaply produced. There are establishments in Nebraska, for instance, fitted for fattening some thousands of cattle in stables arranged with every convenience.

There is every reason to believe, however, that by far the largest percentage of the better grades of beef cattle will continue to be reared and fed in the States properly classified as corn and grass States.

The United States stands easily first among nations in the number of its swine. There has been some decrease in the last few years, but the estimates of the national Department of Agriculture gives the number, January 1, 1888, as 43,544,755, or nearly 75 for each 100 of the human population. This estimate is made at the season of the year when the total number is nearly at its minimum, as a very large percentage of the pigs are produced in the spring months, and vast numbers of fattened hogs are sent to slaughter during the closing months of the year.

The abundant and cheap production of Indian corn is the controlling factor in pork production in the United States. Thus the seven great corn-producing States are estimated to have had, in round numbers, 20,800,000 hogs, or almost half the total, and an average of nearly 3,000,000 for each State. Their respective rank was Iowa, Missouri, Illinois, Ohio, Kansas, Indiana, and Nebraska. No other State had 2,000,000 hogs save Texas, and the poor quality of these largely offset the large number.

The rapidity with which swine increase, the early age at which they may be profitably sent to market, the ease with which the meat may be preserved for future use, and the large use made of the fat, as also the abundance of maize, so well adapted as a fattening food, have made swine-breeding popular in all the great Indian corn growing regions, while the readiness with which one or more pigs may be utilized as profitable means of consuming waste products from the table and dairy, have caused farmers and many village residents in almost every part of the country to annually fatten at least a few pigs.

Much attention has been given to the improvement of the hogs of the country, and it is believed those of no other country surpass the best in the United States.

There is a large number of distinct breeds, but several of these closely resemble each other, except in comparatively unimportant characteristics, and there is a noticeable tendency in the most popular breeds towards greater similarity. Early

maturity, medium to large size, quiet disposition, and the ability to lay on flesh rapidly, even at an early age, are the qualities chiefly desired. No breed above a fair medium size is in general favor in the great pork-producing regions, although several of the smaller breeds are highly prized for village pigs or on farms where but few swine are kept. It is also noticeable that swine of the dark-colored breeds far outnumber those white in color.

The breed most generally found on the farms in the great hog-rearing States is the Poland China—a name somewhat inappropriately given to a breed originating in southwestern Ohio as the product of crossing hogs of various breeds, among which were hogs imported from China and, in the opinion of a minority, some brought from Poland. The Berkshire was used at different times. Whatever its exact origin the Poland China has now marked uniformity. It is almost entirely black in color, although there is little prejudice against white spots on any part of the body. The ear droops at the side of a moderately dished face. The body is deep, legs short. The disposition is noticeably quiet. While reaching great size at maturity —weights of 1,000 pounds not being unknown—the young pigs of this breed are readily made fit for market.

The Berkshire stands second in number and general popularity, and, perhaps, may be said to be a more fashionable breed than the Poland China. As bred in the United States it retains the characteristics which made it popular in England. It is usually uniform in color and appearance, the white extremities and black-haired body, erect ears, dishing face, somewhat prominent shoulders, well rounded body, large hams and appearance of vigor and vitality being readily recognized by any one who has seen even a few specimens. Of late years the average size has been increased without injury to the superior quality of the flesh.

The Chester White is the name of another breed of American development. the name being that of the county in Pennsylvania in which it first gained celebrity. Various crosses were used in producing the breed and, probably, quite as much of its good reputation was due to skillful selection and good management on the part of breeders as to the merits of the foundation breeds. Except for its white color it is not unlike the Poland China. The prejudice against white hogs on the part of so many farmers is a chief reason why it is not more widely bred, as no breed has more earnest friends among good swine-raisers.

Within the last ten years much favorable attention has been attracted by a breed, known by different names, and the origin of which it is not easy to fully trace, but now most generally called the Duroc-Jersey; the first name having been arbitrarily given, the second referring to New Jersey, in which State these hogs were largely bred. They are of a dark red or "sandy" color, of large size, and, as bred a few years ago, somewhat coarse in bone. They are hardy, and, when crossed on breeds which had become, perhaps, overly fine-boned, the results were often very satisfactory. The breed has a good standing in most of the leading pork-producing regions.

Of other breeds of which there are large numbers, although small in comparison with the total number of swine in the country, may be mentioned the Essex, a pure black breed of small to medium size; and the small Yorkshire, of similar size, but white in color, both breeds being noted for early maturity and the unusual ease with which they can be fattened and both well adapted for crossing with larger breeds. There are a number of other breeds of good repute in comparatively limited localities.

A much larger percentage of hogs than cattle are nearly or quite pure bred or else are the product of intentional crossing of distinct breeds. Many good hog-raisers believe cross-bred animals are preferable to those nearly or quite pure of one breed. In some parts of the country, especially in some of the more southern States and in regions where the abundance of forest trees tempts the farmers to allow their hogs to get much of their living from the nuts and roots, the hogs are

of inferior quality, often slow in coming to maturity and of small size, wild in disposition, active and muscular. But the animals of this description form but a small minority of the total.

As in the case of the cattle, the methods of swine rearing and feeding most approved in the United States, as shown by most general practice, are characterized by simplicity, the absence of complicated rations and anything which tends to much increase the quantity of human labor necessary. There is much diversity in the methods pursued with village kept pigs or those reared in sections where land and grains are high priced, but these pigs are chiefly designed for home consumption, rarely reaching the public markets.

In striking contrast with modes of keeping in many countries, the traveler among the farms where hogs are chiefly grown in the central West will, during the summer, almost as certainly find the hogs grazing in the fields or in large grass or clover plats especially reserved for them, as he will the cattle. This general recognition of the fact that the pig is a grazing animal has much to do with the cheapness with which pork is produced, and does much to secure healthfulness among the hogs, largely counteracting the ill effects produced by another practice concerning which there has been much adverse criticism of American farmers—that of using Indian corn too exclusively in fattening hogs, and as their food ration during the winter months.

The more common practice in the Western States among farmers who rear from a score to one or two hundred pigs each year, is to have the litters dropped in April or May; if early, in comfortable but often very cheaply constructed shelters; if later, in the fields or grass yards prepared for them. As early as practicable the pigs are taught to eat grain, and fed corn, oats, or rye, sometimes dry, but frequently soaked in water or in "slops," or ground and mixed with milk or water. Generally large liberty is given. The practice of "ringing," or inserting a wire ring in the nose, thus preventing rooting, is very common, and allows the greater freedom on the grass and clover land, of which there are usually small fields especially fenced for the hogs. The pigs are weaned at from 8 to 10 weeks of age, after which the sows are frequently at once put on full grain feed and sent to market in the early autumn or are bred so as to produce a second litter in the autumn.

There is growing favor to the practice of fattening the earlier litter of pigs, so as to send them to market at 8 months old. The later litters, and those dropped in the autumn months, are kept over the winter and fattened either in the spring or next autumn. Except the brood sows, but a small proportion of the hogs in the best pork-growing regions are now kept until they are 18 months old.

It is a common custom to feed the growing pigs about half as much grain as they would eat during the summer, letting them get the remainder of their food by grazing. As soon as the maize is in, or a little past what is known as "roasting ear" stage, liberal feeding of this is often commenced, in many cases the stalks being cut and fed with the ears. Of this green corn hogs are very fond and gain in weight rapidly on it, especially if they have not been grain-fed during the summer. For finishing the fattening process, mature corn is preferred. The fattening period proper rarely continues over eight to ten weeks. During this time, especially as colder weather comes on, the hogs are most commonly kept in smaller inclosures, to keep them quiet. Many farmers, but only a small percentage of the total, keep their hogs in small pens or houses almost continuously, either because, under some special circumstances, this is the more convenient method, or with a view to rapid development. Large numbers are fattened at cheese factories or other factories at which there is a considerable by-product of vegetable or animal matter, but relatively these are exceptional methods. This may almost be said to be true of feeding ground grains or cooked foods to fattening hogs, although the use of meals, bran, and of oil cake is practiced by thousands. It is certainly true that the great mass of the hogs which are slaughtered in the great markets of the country have been fattened almost exclusively on Indian corn, grass, and clover.

Two notable changes in the market demands in comparatively recent years have greatly influenced the practice of breeders. These changes are a vast increase in demand for hogs of comparatively light weight and a fairly uniform demand throughout the year. Formerly the percentage of hogs slaughtered in the summer months was very small, and the largest demand was for heavy weights. Now large numbers are slaughtered every week during the year, the highest prices often being paid during the spring or early autumn months, and there is a very large demand for hogs weighing 200 pounds or less. The average weight of all the hogs received in Chicago in 1887 was 228 pounds; in 1888, 229 pounds. The average weight of those received in December, 1888, was 262 pounds, an unusually heavy weight, largely consequent on an abundant and rather low-priced crop of Indian corn.

The hogs exhibited year after year at the Fat Stock Show at Chicago may be taken as typical specimens of the best fat hogs of the country. While the weights are often great for age, considerable regard is had by most exhibitors to quality of the carcass and symmetry of form. The average weight of the hogs of all breeds and crosses over 1 year and under 2 years exhibited at this show during eight consecutive years was 436 pounds; of those under 1 year the average weight was 303 pounds. The heaviest hogs over 1 and under 2 years at these shows averaged 591 pounds at average of 428 days, or a gain of 1.15 pounds per day from birth; of those under 1 year the average was 269 pounds at 207 days, or 1.30 pounds gain per day. The percentage of weight of dressedcarcass, including head, to live weight of the hogs slaughtered, at this show during a series of years was 86.

Few classes of live-stock breeders in the United States have manifested more skill, energy, and perseverance than have the breeders of pure-bred swine. Each breed is represented by national and State associations, and each has one or more public records of pedigrees many of which can be traced for several generations. Remarkably high prices are often paid for choice animals for breeding purposes. There are some hundreds of intelligent farmers who make the breeding of pure-bred swine the chief or leading part of their work. From some of these breeding farms there are annually sold from 500 to 1,000 well-bred pigs to be used as sires or dams by other farmers who rear hogs chiefly for the general pork markets. These breeders have done much to improve the hogs of the country and to stimulate interest in swine husbandry. On the other hand the large number engaged in such breeding, and their general prosperity, is evidence of the adaptation of the soil, climate, and crops of the country to profitable swine rearing.

Naturally the center of the pork-producing district is moving westward with the growing population of the great corn-producing States west of the Mississippi River. Taking the chief hog-raising States as a whole, the average value of the Indian corn on the farms where produced is certainly not over one-half cent per pound. Judiciously fed to good hogs from 5 to 6 pounds of corn will produce a pound of pork—under favorable conditions 4 pounds will cause a pound of increase. A good part of the weight of the fattened hog has been made at even less cost, from grass and clover, or from food that would otherwise have been wasted. One year with another the producer has been able to get at least 4 cents per pound for his live hogs. It is evident that, if there were no losses from disease or other unfavorable circumstances, the business would give a good profit, with a probability that the numbers reared would soon be so great as to materially lower prices. There have been marked fluctuations both in numbers and prices in recent years, with some reduction of the total number. From various causes the exports of pork to foreign countries have fallen off. Lower prices for beef and a growing appreciation of mutton have tended to check the home demand. But there is every reason to believe that the United States will long remain the greatest swine-rearing nation, and that pork production will continue to be a profitable branch of American agriculture.

CHAPTER XIII.

ASSOCIATED DAIRYING IN NEW ENGLAND.

By HERBERT MYRICK.

For upwards of two hundred years the farmers in the New England and Atlantic States manufactured at home all the butter they produced. The labor of making the butter was largely done by the women of the household, and constituted one of the chief if not the greatest drudgeries of farm life. Associated dairying made very slow progress at first against the home-dairying custom so long established. Creameries or factories at which whole milk or cream were received from numerous farms, and there made into butter, had been established in various parts of the country prior to 1870. But in the New England States the first creamery was organized in Hatfield, in 1878. Cheese factories had been quite common all through the northeastern portion of the United States, but, except in Vermont, were not very profitable in New England, because the factories could not get a sufficient quantity of milk to enable them to do business at a profit. Consequently, the creamery was viewed with little favor in New England, and predictions of its speedy demise were not few. In addition to the Cooley factories, which constitute over two-thirds of the 150 creameries in New England, there are also quite a large number of milk factories run on the separator system so common in many European countries, the Danish-Weston, DeLaval, and Backstrom separators being used. In the separator system, the farmers deliver the whole milk at the factory, the cream is extracted by running through centrifugal cream separators, and the skimmed milk may or may not be carried back to the farm. In the Cooley cream-gathering system, however, the milk is set in deep setting cans submerged in water. The cream gatherer from the factory visits the farmer's house every day, skims the milk, and leaves the skimmed milk on the farm to be fed out. Both systems have their strong advocates, but the separator or whole-milk system is so well known that this paper is confined to a description of the cream-gathering butter factories which, in New England, have made coöperative dairying more successful than in any other part of the country.

Instead of seeking for a proprietor to build and operate the factory, the New England dairymen insist on having it managed coöperatively. The company is organized on a coöperative basis, each shareholder (the shares are usually $25) having as many votes as shares, while the number of shares one person can hold is limited, so as to have the stock in the hands of as many farmers as possible. This makes them all interested in the creamery's success. The stockholders elect a board of directors, who manage the business by means of a business manager or superintendent and butter-maker, with such assistance as may be required. After paying the annual running expenses, and usually laying aside a quarter of a cent per pound additional with which to create a reserve fund to meet extra expenses, the entire balance of the receipts is paid to the patrons. The expenses include 5 or 6 per cent per annum on the capital invested in the factory, but this is the only financial advantage the patrons who are stockholders enjoy over those who are not

shareowners. The capital required varies from $2,000 to $4,000, about $3,000 being the average capital of our coöperative creamery companies. Where the site is given and much of the work of construction and grading is voluntary, the expense of starting is less. These creameries have been so successful as to multiply rapidly during the past half dozen years, until there are about 150 where there were but few eight years ago. Plate XXIV represents a general view of one of these New England creameries and gives an accurate idea of the general size and character of these institutions.

The Amherst Coöperative Creamery, located in Hampshire County, Mass., is an excellent type of these institutions. It started in 1882, amid the distrust and disadvantages common to any undertaking wholly new to farmers who have had no experience in coöperation. The original capital was $3,000, which sufficed for building and equipping an excellent factory, but, after several years, difficulty was experienced in securing perfect drainage, and it became necessary to build a new factory. This change has involved considerable extra expense, and is an exceedingly valuable lesson to all builders of creameries. Absolutely perfect drainage and pure water are the first requisites to a successful butter factory. Each patron is supplied with a creamer, the water in which must be kept at a certain temperature, so that as the milk is submerged (that is, the can, cover and all, put entirely under the water), all the cream is raised under essentially the same conditions and is practically equal in quality. This does away with the great inequalities that would exist if the milk were set in a variety of cans, and makes all parties feel that they are equally paid. To preserve the proper temperature in summer, ice is used in the creamers, so that every patron must have an ice house. This was at first regarded as a hardship, but after one summer's experience with plenty of ice no farmer's family can do without it. The creamery has been a blessing by compelling farmers to provide ice, as well as by wholly relieving the household of the drudgery of butter-making, to say nothing of the work of marketing, low prices, "store pay," a poor yield and all the disadvantages of butter-making on the average farm.

The cream-gatherer from the factory goes his rounds daily (sometimes only three times a week where cream supplies are short, in bad winter weather, the patrons being allowed to skim the milk the alternate days and keep the cream submerged until the gatherers call for it), skimming the cream from the cans so that the farmer has nothing to do but to milk his cows, strain the milk into the cans, and wash them after the cream-gatherer has departed; the rest of the labor is performed at the factory. When the gatherer arrives at the creamery he unloads his cans on the rear platform. They are carried into the receiving room and the contents poured through strainers into the cream-tempering vats below. These vats and the room in which they are placed are so constructed as to preserve any desired temperature, the even and uniform ripening of the cream being essential to the best product. Cream can be drawn directly to the churn, and the buttermilk flows from the churn by a pipe of glazed Akron tile into the buttermilk tank 25 rods distant, from which it is drawn off by the farmer who buys it to feed his hogs or hens. Another long drain carries off the wash-water, while the boiler furnishes hot water and the engine does all the pumping. The butter is put almost wholly in pound prints, and sells in the neighboring markets, comparatively little surplus being put into tubs and shipped to New York or Boston. Five cream-gatherers, a superintendent who is also chief butter-maker, and who has one, and, much of the time, two assistants, with a treasurer who keeps the accounts, constitute the working force employed in manufacturing the cream into 800 to 1,500 pounds of butter per day. The cream is all gathered within a radius of 6 miles from the factory, the longest cream route being about 20 miles for the round trip.

GENERAL VIEW OF NEW ENGLAND CREAMERY.

THE WHITE MOUNTAIN CREAMERY, LITTLETON, NEW HAMPSHIRE.

An idea of just what is accomplished is best given by the following statement of the business done for the past six years:

	1888.	1887.	1886.	1885.	1884.	1883,
Product:						
Spaces of cream received....	1,766,168	1,652,639	1,383,533	1,037,606	616,440	399,324
Pounds of butter made......	271,103	254,894	215,788	160,004	97,159	6,776
Spaces of cream to make 1 pound of butter..........	6.46	6.47	6.47	6.30	6.31	6.36
Receipts:						
For butter	$74,898.00	$69,339.00	$53 566.00	$43,589.00	$32,436.00	$18,496.00
For cream	155.00	144.00	132.00	183.00	479.00	376.00
For buttermilk.	480.00	492.00	334.00	399.00	450.00	393.00
Total sales	75,553.00	69,974.00	58,957.00	44,171.00	33,365.00	19,265.00
Receipts per pound...cents..	28.62	27.45	27.88	28.48	30.67	30.54
Expenses:						
Total expenses...............	$12,928.00	$11,208.00	$9,054.00	$7,128.00	$4,447.00	$2,840.00
Expenses per pound of butter... ....cents..	4.45	4.40	4.22	4.41	4.68	4.59
Payments:						
Amount paid patrons *......	$62,645.00	$58,766.00	$49,878.00	$37,043.00	$28,918.00	$16,426.00
Average payment per space of cream *........cents..	3.63	3.55	3.64	3.82	4.10	4.09
Average payment per pound of butter *........cents..	23.60	23.05	23.66	24.07	25.99	25.95
Average number of patrons.....	172	165	152	120	80	49

* These payments are net to the patrons. No deductions or allowances are taken out of them. They show the net sum paid the patron for his cream taken at his door.

The steady increase in the business done shows how well the factory has satisfied the coöperative proprietors. It is also evident that the patrons have cheerfully complied with the regulations as to feeding of cows and caring for the stock, stables, creamers, etc., for, without this essential coöperation, the product would have fallen off in quality—the beginning of misfortune. First class butter-makers, intelligent marketing, and accurate keeping of accounts have also been inseparable in the success of this and other New England coöperative creameries. In short, first-class business management is needed—such as prudent men quickly learn from experience and observation. Making butter the year through—almost as much in December and January as in June—is another key to the success of our creameries. Indeed, it may be laid down as a rule that the greatest profit in associated dairying is secured only when as much butter is made in winter as in summer, and if the surplus can come in January instead of June so much the better. A statement by months of the chief items of Amherst's business will illustrate how well it carries out this cardinal principle—and a hundred other New England creameries adopt the same policy:

Monthly reports for two years.

Months.	Butter made.		Received per pound.		Expense per pound.	
	1888.	1887.	1888.	1887.	1888.	1887.
	Pounds.	*Pounds.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January..................	21,986	19,714	30.82	29.88	4.28	4.29
February	20,434	18,250	30.66	28.90	4.26	4.32
March..................	21,869	23,395	30.42	28.90	4.65	5.14
April..................	22,661	23,543	28.57	27.91	4.24	4.79
May..................	24,505	25,639	27.38	24.88	6.77	3.55
June..................	25,933	25,506	24.08	23.29	4.45	3.82
July..................	23,275	22,298	24.92	23.98	3.94	4.19
August..................	20,072	20,395	27.15	27.40	4.74	4.85
September..................	19,497	18,171	28.80	27.92	4.48	4.94
October..................	20,709	18,902	29.53	29.59	4.92	5.01
November..................	21,809	19,280	30.57	28.49	4.57	3.64
December..................	22,869	20,872	30.59	30.52	4.11	4.57

The construction and equipment of a modern cream-gathering butter factory is still better shown by this accompanying model (see plan of creamery. Fig. 211) of the new creamery at Schuylersville, Saratoga County, New York, for it should be understood that the remarkable success of the New England creameries has led to the adoption of the system in many of the States. Now, to refer to the model creamery herewith exhibited:

On the left end, as you stand facing the creamery, is the receiving room, with a crane for raising the cans of cream and dumping them into the receiver with strainer, the spout of which passes through the partition and into the cream vats in the next room towards the right. In the receiving room also is a sink supplied with hot and cold water, and a steam jet for washing the cans and steaming them out without taking them into any other part of the creamery. This is an important aid in preserving the strictest cleanliness throughout the factory. The sink is connected with the drain. Back of the receiving room is the office, connected by a door with the receiving room, and also connected with the cream room by a door.

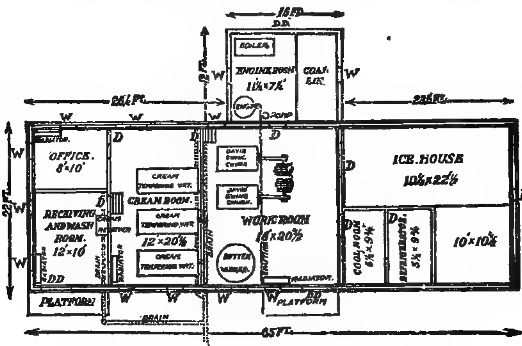
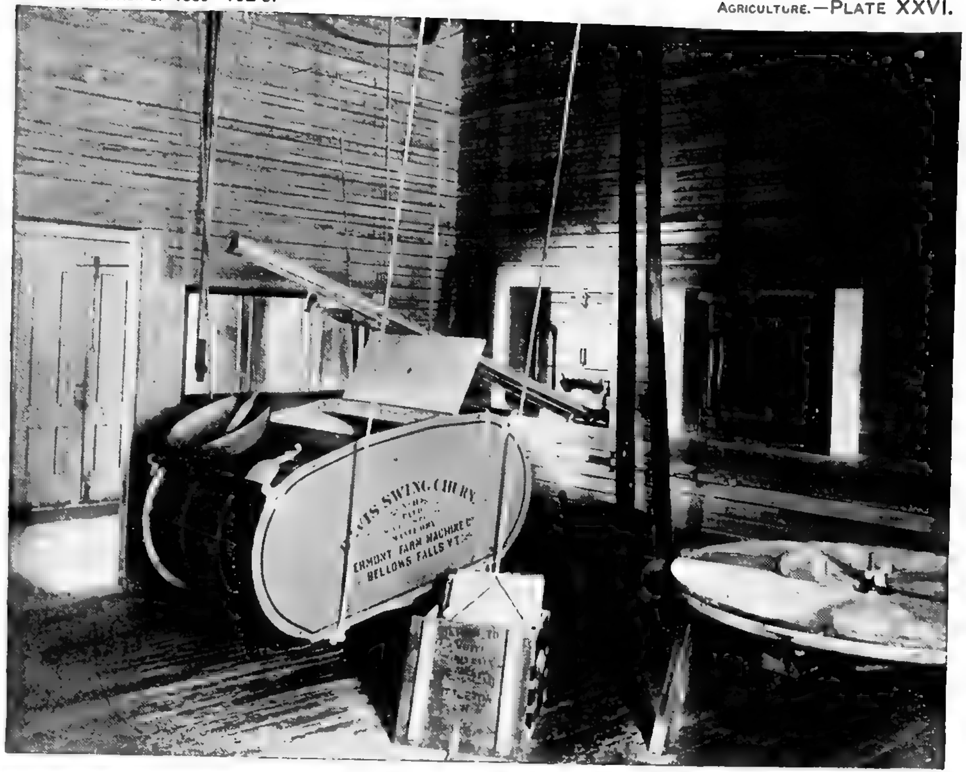


FIG. 211.—Plan of the Schuylersville Creamery.

To the right of the receiving room is the cream room in which the cream-tempering vats stand. There are two cream vats in the model, their ends projecting through the partition between the cream room and the workroom. They are fitted with pipes for running water, and also with steam and overflow pipes. These vats are of 250 to 500 gallons capacity, and as many are used as are required to hold the supply of cream. These vats play an important part in butter-making, as in them the cream is "ripened" at precisely the proper temperature, which varies with the age of the cream. The temperature is regulated by letting steam or cold water into the space or double walls surrounding the vats. The accompanying illustration gives a plainer insight into the construction and use of the cream-tempering vats.

Next to the right of the cream room is the workroom above-mentioned, which contains a Davis swing churn and a Cooley power worker. This worker is a circular table with two smooth rollers. Most workers that run by power have corrugated rollers; this one is comparatively new and is being watched with interest. The rollers are fitted so as to automatically raise and lower with the thickness of the butter. In this room is the table with butter bowl and ladles, and the sink furnished with hot and cold water for washing anything that needs to be washed. The floor drains into a gutter on one side which connects with the drains.

Special attention should be given to the construction of the floor in the workroom. It should be of an impervious cement, with a coating that will be as smooth, hard, and impervious as slate. This material will never soak up buttermilk, and can always be kept clean by frequent washings. This point is absolutely essential to the perfect cleanliness which must be constantly maintained in every department of the



WORKROOM IN WHITE MOUNTAIN CREAMERY.

REFRIGERATOR AND WORKROOM IN WHITE MOUNTAIN CREAMERY.

butter factory. Great care should be taken, also, that the workroom in particular is well lighted, especially to insure cleanliness.

Next to the right of the workroom are the refrigerator rooms and the ice house. The plan illustrated in the model is used in a number of creameries with great success, and may be varied in size to suit the requirements of the builder. In the Schuylersville creamery, which is illustrated by the model, the cold storage or refrigerator room is 10 by 12 feet in size, and divided equally by a partition into two compartments, each 5½ by 9¾ feet, the first being styled the cool room; and beyond is the refrigerator proper. An ice box 4 feet square and 12 feet long is put over the room and connected with the room below by flues constructed in the wall. These flues may be simply the space between the studs and joists, and must receive the air from the ceiling on the side of the room next to the ice, and be connected with the top of the ice box. These flues carry the warm air, which rises to the ceiling into the ice box. From the sides, at the bottom of the ice box, other flues run to within 6 inches of the floor of the refrigerator and enter the rooms, one in each room. These carry the heavy air after it is cooled in the ice box, to the room below. A slide should be put in the flue conducting the cold air from the ice box to the floor so as to regulate the temperature or cut off the cold entirely. The rooms must be tight, so that no air can enter them from the outside; and great care must be taken to have the flues tight, so that no air will enter them except from the ice box and the ceilings of the storage room. The ice box must be lined with galvanized iron, and a drip pipe provided to carry off the melting of the ice. This drip pipe must be arranged so that no air can enter it from the bottom.

The ice box has a partition across it corresponding to the partition in the storage room. There must be a thick cover fitting tightly to the box where the ice is put in. This cover should be made in two sections, one for each side of the partition. The ceiling over the cold rooms, which is not covered with the ice box, should be covered with galvanized iron, laid so as to run the water from the melting ice into a drain. This pipe also must be arranged so that no air can get into the lower end. Paper should be put in under the galvanized iron everywhere to prevent condensation and consequent drip. Too much care can not be taken that everything is tight about the cold storage, especially the flues and doors. In large creameries, where this method of building refrigerators is in use, the air in the refrigerators is so dry that a match can be lighted on any part of the walls. This dryness is an important point in keeping butter, for in a moist refrigerator it will be likely to be contaminated.

The rest of the creamery building beyond the refrigerator, a space 10 by 10½, and the large space in front of the refrigerator, 10½ by 22½ feet, is used as an ice house and is stored full of ice in winter. The construction of the outside walls of the ice house is the same as for the rest of the main building. The inside walls are sheathed to the upper floor joists, above which the space is left open for ventilating purposes. The bottom of the ice house is arranged to give good drainage, so that the drip from the ice is carried outside the building. The ice is piled within 8 or 12 inches of the walls, which space is filled with sawdust or other packing. A foot of the sawdust, or 2 feet of meadow hay or straw chaff on top, completes the ice compartment.

Back of the main building is an L-shaped extension containing an engine room 11½ by 14 feet, and also a coal bin. The accompanying illustration (Fig. 211) shows the arrangement of the entire structure, which is 65 feet long by 32 feet wide.

Such a building can be put up for from $800 to $1,500 in the United States, according to locality and finish. It is large enough to accommodate the cream of from 1,000 to 1,500 cows. The cost of the boiler, engine, cream vats, churns, etc., will be from $750 to $1,000. This expense is borne by the creamery company. In addition, each patron has to obtain the creamer in which the cans containing the milk are submerged beneath the water, having a cover which operates on the principle of

the diving bell to keep out the water. The entire expense of such a factory, and the entire outfit will be from $2 to $5 per cow, the price depending largely upon the style of the apparatus selected and the capacity of the cow. Here, as in the operating expenses, the more business done the less the total cost per pound of product.

The advantage of this form of construction, which is the evolution of the creamery after years of experience, are manifold. In the first place, this is the cheapest form to build; second, it is very convenient; third, it permits of a tenement being built above the creamery or basement used for the factory; and fourth, it places the engine, boiler, and coal bin, with their accompanying heat and dirt, in a cheap compartment entirely apart from the main building. A storage room or basement may also be put under the receiving room and office.

The creamery is built on a stone or brick foundation, with sills 6 by 8 inches. The wall on the front side, for a length of 24 feet, is raised 3 feet higher than under the rest of the building, so that it may be graded up to raise the cream wagons on a level with the receiving platform. Of course, if built in a side hill, no such grading will be required. The joists of the elevated floor are 2 by 8 inches in size, spiked to studs, and supported in the center by 4 by 6 timbers, shored up on pillars. The ends are shored up by 2 by 4 studs. The outside walls have 2 by 4 studs 14 feet long. On these are nailed rough 1-inch boards to which building paper is tacked, and over this 1-inch strips or battened siding or clapboards are nailed. On the inside of the studs rough boards are nailed, then paper, furred out with inch strips and sealed with seasoned sheathing, clear white pine or white wood with a shellac finish being best. This leaves three air spaces. In case it is desired to save the expense of rough boarding, tack the paper to the sides and fur out 1 inch. Then ceil and side as above. For the partitions, set the studs flatwise and ceil on both sides of the studs leaving a 2-inch air space.

THE LESSONS OF EXPERIENCE.

Average creamery butter brings at wholesale from 3 cents to 6 cents more per pound than average dairy butter. Suppose 100 farmers with 10 cows each, making their butter at home with all the drudgery this implies, average 150 pounds of butter per cow per year, for which 20 cents is received, making the receipts per cow $30 per year for the butter alone. Let these same farmers organize a coöperative cream-gathering butter factory, and they will net 22 cents to 25 cents per pound for their butter and get more per cow—at least 170 pounds, thus receiving $38 to $43 per cow per year, with none of the work of butter-making or selling. This is a moderate estimate. It has been exceeded in many cases. Many farmers get $50 to $75 per cow per year net for their cream alone, and instances of $90 to $100 (including the skim milk) are well attested.

The coöperative or mutual features of several of these creameries is emphasized by sending to each stockholder a monthly itemized statement of the expenses, showing just where every cent goes. These circulars cost but a trifle and enable a stockholder to keep informed. If he is dissatisfied with anything, he can find fault with it directly, and thus extravagance and errors are guarded against.

As to the average returns of the New England cream-gathering butter factories it was stated at the meeting of the Connecticut State Board of Agriculture at Danbury, in December, 1888, that where the patrons of these creameries were unable to sell the skim milk, and kept it at home, the return they received for their butter was equivalent to 2¾ cents per quart for all the milk they used in producing cream; that is to say, the well-managed coöperative creameries take the cream at the farmer's door, manufacture it, sell the butter, and return him enough from the butter made from his cream to be equal to 2¾ cents for every quart of milk set to raise that cream. This is the average of the entire year. Some creameries do much better,

and a few go below this. Moreover, the farmer has the skim milk left on his farm to either feed or sell. With the most careless feeding the skim milk is worth ¼ of a cent per quart to feed, so that at the lowest calculation the creamery patron nets 3 cents per quart for the milk without robbing the farm of the plant food in the milk. The farmer also has none of the work of butter making and selling and does not have to deliver his milk or cream.

Another advantage of the creamery system is that the patrons are led to keep a better quality of cows. The cows are necessarily tested as to their butter-producing qualities. No farmer will keep a cow that gives only five or six spaces of cream daily when on the same feed another cow will produce eight or ten spaces of cream butter daily. The cows are better fed, better cared for, and more cleanliness about the stable is observed where there is a good creamery. It also provides an outlet for all the milk that can be produced and at a remunerative price. This encourages the keeping of all the cows that the farm is capable of, and also the increasing of the number of cows as the farm improves. This means more manure, and that means more grass and more feed and consequently richer and more productive farms.

A good location is of paramount importance. A mistake here is beyond remedy. A dry soil, good drainage, good spring water, a northern exposure of the work-rooms, a ground floor, and convenience to the highway, railroad station, and express office are features to be borne in mind in locating a factory.

The greater the quantity of butter made from the same outfit or creamery plant the less the actual expense per pound of butter. Thus the coöperative creamery at Windsor, Connecticut, made, in 1888, 30½ per cent more butter than in 1887, paid ts patrons 12½ per cent more per pound, and the total expenses were only 9 per cent more, while really less per pound.

It takes from 20 to 23 pounds of milk by this system to make 1 pound of butter. The dairies furnishing cream to the Wapping (Connecticut) creamery average 12 spaces of cream on 17 quarts of milk and the milk will weigh 36.83 pounds. The average number of spaces required for a pound of butter at this factory last year was 6.51 spaces, so that the average amount of milk required for a pound of butter was only 20 pounds at the Wapping creamery. A number of other coöperative creameries probably do as well, but this is believed to be above the average.

A fair sample of the way in which these coöperative butter factories increase their business is also shown by the experience of the Ellington (Connecticut) factory. When it began business in 1884 it had only twenty patrons, and at first made only 79 pounds of butter per day. It now has nearly one hundred patrons, and last year made as high as 1,000 pounds of butter daily. The following is a statement of a summary of each year's business:

Year.	1888.	1887.	1886.	1885.	1884.
Pounds of butter made	203,834	149,097	118,107	80,672	15,737
Spaces of cream to make 1 pound of butter	6.51	6.56	6.41	6.28	6.23
Total expenses per pound of butter made, cents	4.32	4.88	5.31	6.52	9.74
Average payment, net. to patrons for each pound of butter made, cents	25.86	24.13	22.41	20.39	21.29
Average paid patrons per space for cream, cents	3.96	3.69	3.49	3.31	3.37
Total expenses of the creamery	$8,775.34	$7,290.84	$6,183.43	$5,261.11	$1,532.78
Total receipts for the year	60,864.25	43,399.48	31,102.00	21,719.93	4,926.92

Certain remarkable points in this record deserve to be emphasized. Notice that with increased business there has been a constant reduction in the average expenses per pound of butter produced, and that in 1888 the expenses per pound were over 50 per cent less than 1885, while the production increased 150 per cent. The fact that an average of about 26 cents per pound was returned to the patron for the butter in 1888 shows that the product must have been of the very highest quality, for it averaged over 30 cents per pound during the entire year. Indeed, this factory

claims the distinction of commanding the top of the market and selling on the average for a higher price than any other creamery in the Eastern States. Its product in December, 1888, and January, 1889, sold as high as 38 cents per puond. While the increased business reduced the expenses to less than 4⅛ cents per pound, it should be noted that the total expenses of the creamery in 1888 were only about 62 per cent greater than the expenses of 1885, while the product in 1888 was 150 per cent more than the product of 1885. In other words, the ratio of expense to increase of business was 1 to 2, emphasizing most clearly the benefits of doing as large a business as the plant will accommodate.

Further reports from the creameries, taken from the New England Homestead, of Springfield, Massachusetts, show that the instances above quoted are not exceptional.

Monthly reports for October, November, and December, 1888, *and January,* 1889.—Colchester (Connecticut) creamery received in November 29,636 spaces of cream and made 4,268 pounds of butter, all of which sold at 28 to 32 cents per pound. The average cost of manufacture was 7.44 cents per pound. Patrons received 3½ cents per space for cream, equivalent to 24.29 cents per pound for butter.

Ipswich (Massachusetts) creamery received in October 43,868 spaces of cream, and made 6,560 pounds of butter. Paid patrons 4 cents per space for cream, equivalent to 26.72 cents per pound for butter. It required 6.68 spaces of cream per pound of butter. Received in November 39,769 spaces of cream and made 5,933 pounds of butter, all of which sold. Patrons received 4 cents per space for cream, equivalent to 26⅘ cents per pound for butter. It required 6.7 spaces of cream per pound of butter.

Glastonbury (Connecticut) creamery received in November 37,690 spaces of cream and made 3,433 pounds of butter, all of which sold at 29 to 32 cents per pound. The average cost of manufacture was 5½ cents per pound. Patrons received 3.8 cents per space for cream, equivalent to 26⅛ cents per pound for butter.

Canton (Connecticut) creamery received in November 80,227 spaces of cream, and made 12,442 pounds of butter, all of which sold. Patrons received 4⅛ cents per space for cream, equivalent to 26.56 cents per pound for butter.

Windsor (Connecticut) creamery received in November 46,169 spaces of cream and made 6,860 pounds of butter, all of which sold. Patrons received 3⅞ per space for cream, equivalent to 26 cents per pound for the butter. It required 6.7 spaces of cream per pound of butter.

Contoocook Valley creamery, of Henniker, New Hampshire, made in December 4,472 pounds of butter, all of which sold at 27 to 35 cents per pound. The average costof manufacture was 4.58 cents per pound. Patrons received $1,207.65 for cream furnished, equivalent to 27 cents per pound for butter.

Conway (Massachusetts) creamery received in December 180,385 spaces of cream and made 28,794 pounds of butter, all of which sold at 25 to 34 cents per pound. The average cost of manufacture was 3.69 cents per pound. Patrons received 4.1 cents per space for cream.

North River creamery, of Whitingham, Vermont, received in December 28,161 spaces of cream and made 4,152 pounds of butter, all of which sold at 28 to 30 cents per pound. The average cost of manufacture was 4⅛ cents per pound. Patrons received 3½ cents per space for cream, equivalent to 23.8 cents per pound for butter. It required 68 spaces of cream per pound of butter.

Hampton creamery, of Easthampton, Massachusetts, received in December 47,163 spaces of cream and made 7,540 pounds of butter, all of which sold at 26 cents per pound net at the creamery. Patrons received 4.1 cents per space for cream, equivalent to 26 cents per pound for butter. Average cost of manufacture, 3.81 cents per pound.

Riverside creamery, of Enfield, Connecticut, received in November 19,571 spaces of cream and made 2,978 pounds of butter. Patrons received 3½ cents per space

for cream. The first butter made by the creamery was on November 1, and the payment for cream for the first month's business is very gratifying to the management. The Dècember showing is even better.

Cummington (Massachusetts) creamery received in November 50,681½ spaces of cream and made 7,813 pounds of butter, all of which sold at 28 to 31 cents per pound. The average cost of manufacture was 3.42 cents per pound. Patrons received 3.7 cents per space for cream, equivalent to 24.05 cents per pound for butter.

East Granby (Connecticut) creamery received in November 36,293 spaces of cream and made 4,739 pounds of butter, all of which sold, besides selling 2,606 spaces of cream. Average cost of manufacture 4¾ cents per pound. Patrons received 3.6 cents per space for cream, equivalent to 25 cents per pound for butter.

La Grange (New York) creamery received in December 32,245 spaces of cream and made 4,765 pounds of butter, all of which sold at 33½ cents per pound at the creamery. Patrons received 4¼ cents per space for cream, equivalent to about 28.76 cents per pound for butter. Average cost of manufacture 4.76 cents per pound.

Canton (Connecticut) creamery received in December 87,299 spaces of cream and made 13,480 pounds of butter. Patrons received 4⅛ cents per space for cream, equivalent to 26.69 cents per pound for butter.

Colchester (Connecticut) creamery received in December 30,088 spaces of cream and made 4,184 pounds of butter; sold 4,180 pounds at 28 to 33 cents per pound. Average cost of manufacture 7.59 cents per pound. Patrons received 3½ cents per space for cream, equivalent to 25.16 cents per pound for butter. It required 7.19 spaces of cream to make 1 pound of butter.

ANNUAL REPORTS FOR 1888.

Conway (Massachusetts) creamery received in the 12 months ended January 1, 1,409,972 spaces of cream and made 229,352 pounds of butter. The average cost of manufacture was 4.15 cents per pound. Average price paid patrons for cream 3.912 cents per space.

Windsor (Connecticut) creamery received in the 12 months ended January 1, 1,663,078 spaces of cream and made 102,725 pounds of butter. The patrons received an average of 3.73 cents per space for cream, equivalent to 24.29 cents per pound for butter. The average spaces of cream required per pound of butter was 6.49. The total average cost of manufacture, selling, etc., was 5⅝ cents per pound. The highest price paid for cream was 4⅛ cents for October cream, and the lowest was 3⅛ for June cream.

The following is a statement of the business of the Wapping (Connecticut) Creamery and Butter Factory, by months, for the year 1888:

1888.	Cream received.	Butter made.	Cream required to make 1 pound butter.	Amount paid patrons.		Expense per pound of butter-making.
				Per space.	Equivalent per pound for butter, net.	
	Spaces.	*Pounds.*	*Spaces.*	*Cents.*	*Cents.*	*Cents.*
January	89,365	13,175	6.76	4.25	28.73	5.27
February	90,436	13,494	6.68	4.25	28.40	4.97
March	97,769	15,450	6.32	4.25	26.86	4.74
April	98,683	14,959	6.59	4.00	26.36	5.03
May	116,470	18,222	6.39	3.70	23.64	4.57
June	120,893	18,614	6.49	3.25	21.09	4.24
July	109,533	17,063	6.42	3.25	20.86	4.33
August	100,316	15,399	6.51	3.50	22.78	4.66
September	96,838	14,330	6.75	3.70	24.97	4.64
October	90,990	14,512	6.27	4.10	25.70	4.90
November	74,056	11,183	6.62	4.10	26.14	5.50
December	84,759	12,601	6.72	4.00	26.88	4.75
Total	1,170,108	179,002	*6.53	*3.8625	*25.22	*4.79

*Average.

95 patrons and 850 cows. Frank Avery, superintendent.

Note amount of butter made in the winter months and the high price received. Also the average product per cow of about 225 pounds butter per year, or over $55 per cow net annually. Also note that each patron received in the average $500 net for his cream in 1880 and had the skim milk to feed or sell.

The Le Grange Creamery, near Poughkeepsie, New York, had sales of $18,048.66 for the year 1888. Its expenses were only $2,884.55, and it returned the patrons $15,164.11. The business of the creamery, by months, is presented below, showing that the average price returned to patrons was over 25 cents per pound for the whole year. It took 6.62 spaces, as the average for the year, to make a pound of butter, varying from 6.21 to 6.9; the butter sold at 26½ to 34½ cents, averaging 30½ cents.

1888.	Cream.	Butter.	Paid per space.	Paid per pound.	Expenses per pound.
	Spaces.	*Pounds.*	*Cents.*	*Cents.*	*Cents.*
January	15,616	2,263	3.87	26.14	7.72
February	15,605	2,498	4.25	27.06	7.00
March	19,875	3,047	4.00	37.74	5.76
April	21,770	3,507	4.00	26.56	5.58
May	35,759	5,406	3.50	24.00	4.34
June	48,941	7,121	3.33	22.91	3.79
July	47,212	7,059	3.50	24.47	3.80
August	43,994	6,910	3.50	23.16	4.00
September	41,302	6,236	3.40	22.51	4.00
October	41,797	6,252	3.50	23.40	4.00
November	31,978	4,601	3.66	25.73	4.90
December	32,245	4,765	4.25	28.76	4.74
Total	396,094	59,665	*3.73	*25.24	*4.97

*Average.

The following statement shows the business of the Coöperative Cream-gathering Butter Factory at Ipswich, Massachusetts, for 1888. This factory is in a milk-shipping section, but it will be noticed that it returned its patrons a net price (within a fraction) of 26½ cents per pound for every pound of butter made during the year. As it did not take over 20 pounds of milk to make 1 pound of butter at this factory, this payment is equivalent to nearly 1¼ cents per pound of milk, or between 2½ and 3 cents per quart for the milk from the cream alone, leaving the skim milk on the farms. Farmers who sell whole milk to the contractors who ship to large city markets do not receive on an average much over this price. Indeed, an average of 3 cents per quart for whole milk the year around is above the average prices paid to farmers who supply the cities of Boston and New York. Consequently, this factory and others that have been similarly successful, pay their patrons nearly as much for the cream alone as the wholesale market pays for whole milk. Besides this, the farmer has the skim milk to feed or sell, and if a stockholder in the creamery he gets 5 or 6 per cent interest on the stock.

The following is a statement of the business of this factory for 1888:

1888.	Butter made.	Spaces per pound.	Expenses per pound.	Paid to patrons per pound.	Paid to patrons per space.	Total expenses.	Total receipts.
	Pounds.	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	5,424	6.78	6.19	28.81	4.45	$335.74	$1,905.97
February	5,392	6.63	5.23	28.17	4.45	281.00	1,802.18
March	6,089	6.73	4.40	28.60	4.45	267.91	2,064.99
April	6,798	6.56	5.07	27.88	4.45	344.65	2,175.71
May	8,289	6.05	5.02	24.20	4.00	417.11	2,468.51
June	9,790	6.24	3.04	24.96	4.00	297.61	2,741.50
July	8,784	6.27	4.19	23.51	3.75	368.04	2,435.92
August	7,565	6.14	5.44	24.56	4.00	411.53	2,274.56
September	6,830	6.28	5.48	25.12	4.00	374.28	2,089.79
October	6,560	6.68	4.18	26.72	4.00	274.21	2,063.43
November	5,933	6.70	6.10	26.80	4.00	361.91	1,902.13
December	5,943	6.98	4.85	27.92	4.00	288.23	1,959.46
Total	83,797	*6.50	*4.93	*26.44	*4.06	4,017.22	25,884.15

*Average.

The White Mountain Creamery, at Littleton, New Hampshire, has a building 22 by 52 feet, with studs 14 feet high. (See Plates XXV, XXVI, and XXVIII.) The cellar is 9 feet, with a stone wall, except at the left-hand end, which contains the ice house. The ell contains the engine, boiler, sinks, etc. The main floor is divided into six rooms, much in the same style as the model. The refrigerator in this creamery is especially noticeable. In the partition which forms the front wall to the refrigerator, between the refrigerator and the workroom, there are eighteen small doors, which open into as many compartments, 18 inches wide, 30 inches deep, 10 inches high. In each of these are five hard-wood rollers that extend across the compartment. These rollers permit the boards to be put in and taken out easily. The print butter is placed on these boards for cooling and storage until packed in the cases for shipping. Below these compartments are four larger openings through which the bowls of butter are put into the refrigerator for cooling after the first working. It can readily be seen that these conveniences save the butter-maker many steps and much labor. This is a new creamery that began operations in May, 1888. It is located among the White Mountains of northern New Hampshire, where it has been claimed the cream-gathering system could not work. The business done is shown in the following statement:

Month.	Cream received.	Price per space.
	Spaces.	*Cents.*
June	67,208	3
July	70,718½	2⅓
August	49,972⅓	3
September	42,504	3
October	38,269½	3

There was a small run in November, for which 3 cents per space of cream received was paid. The creamery began with 43 patrons, and within three weeks increased to 75, making between 400 and 500 pounds of butter daily.

CHAPTER XIV.

THE DAIRY INDUSTRY OF THE UNITED STATES.

By H. H. WING.

In a country of so great extent and with so many varieties of soil and climate as the United States, it is not to be expected that the various industries will be equally developed over the whole country, but that each will be most extensive and best developed in those places where the soil, climate, and other natural conditions are most favorable. Consequently we find that, while cows are kept in large numbers, and while milk, butter, and cheese are produced in considerable quantities in all parts of the country, there are certain favored localities where this industry is the leading, if not the sole, occupation of the agricultural community.

These distinctively dairy regions are all in the more northerly portions of the country, but they extend from east to west as far as the country has been settled. The climate is the climate of the colder part of the temperate zone, the soil is generally fertile, though often hilly, and is well adapted to the growth of the grasses, and there is an abundance of pure water from either wells, springs, or running streams. In the States of New York, Wisconsin, Vermont, Iowa, and part of Minnesota dairying is the leading agricultural industry, while in the States of Maine, Massachusetts, Pennsylvania, Ohio, Michigan, Missouri, Nebraska, and the Territory of Dakota it forms a very important part of farm practice.

The distribution of milch cows will give a very accurate idea of the extent of dairying in the different parts of the country. The latest available returns are those made to the Department of Agriculture in January, 1888, a summary of which is given below:

State.	Milch cows.	Average value per head.	State.	Milch cows.	Average value per head.
New York	1,540,053	$30.50	Kansas	640,081	$22.41
Iowa	1,255,432	23.30	Indiana	556,961	27.75
Illinois	937,476	26.50	Wisconsin	548,222	23.83
Pennsylvania	929,371	28.60	37 other States and Territories	6,155,362	....
Ohio	783,481	29.20			
Texas	772,716	14.20			
Missouri	737,259	20.25	Total in the United States	14,856,414	24.65

It will be seen that about four sevenths of the cows are found in ten States. Some of these States, as Missouri and Texas, are not, however, distinctively dairy States, but make a large showing in numbers of milch cows, because stock-growing is an

important industry in those States, and cows that are running at large on the range and suckling calves are classed as milch cows, while as a matter of fact but very few of them are ever milked at all.

In the following table the States are arranged in the order of the largest percentage of milch cows in relation to other cattle. It gives a rather better idea of the States that are most extensively engaged in dairying, several small States that did not appear at all in the other table being found quite well up in this. In this table are included only the States included in the first table and such other States in which more than 50 per cent of all the cattle are milch cows.

Rank.	State.	Number.	Percentage.	Average value per head.
1	New Jersey	178,114	72	$35.92
2	New York	1,540,053	64	30.50
3	Massachusetts	180,319	63	34.17
4	Rhode Island	22,883	63	35.75
5	Vermont	225,552	56	28.70
6	Connecticut	127,153	54	33.71
7	Pennsylvania	929,371	52	28.60
8	Delaware	28,683	51	30.00
9	Wisconsin	548,222	46	23.83
10	Ohio	783,481	45	29.20
11	Illinois	937,476	39	26.50
12	Indiana	556,961	38	27.75
13	Iowa	1,255,432	37	23.30
14	Missouri	737,259	34	20.25
15	Kansas	640,081	29	22.41
16	Texas	772,716	11	14.20

The States included in the above table fall quite naturally into three groups so far as their dairy industry is concerned.

The first, comprising the States down to and including Delaware, is made up entirely of Eastern States. Many of them are quite small in area, and the surface in all is more or less broken and hilly. The live-stock industry is almost wholly devoted to dairying, and, as a consequence, of the total number a very large proportion of the cattle are cows. An important part of the dairying in this group is the furnishing of milk for immediate consumption to the numerous large cities. Most of the larger condensed-milk factories are also in this region. Of the remaining milk about equal portions, as far as may be estimated, are made into butter and cheese.

The second group is made of the States of Wisconsin, Ohio, Illinois, Indiana, Iowa, and Missouri. They are States of large size, with extensive areas of level or nearly level prairie land, in which the grasses grow naturally, abundantly, and luxuriantly. They are also extremely well adapted to the growth of Indian corn, and for the most part are situated in what is known as the "great central corn belt," and are therefore great beef-producing States, with dairying as a very important though still secondary part of the cattle industry. Of the dairy products of this region butter undoubtedly leads, though large quanties of cheese are made in some localities, notably Wisconsin, and several large cities claim a large amount of milk for immediate consumption.

The last two States of the list, as has been said before, are not distinctively dairy States; but they are of large size, and immense herds of cattle run at large on their extensive grassy plains, which accounts for the large number of cows credited to them. However, as the country becomes better settled the dairy industry extends farther west and southwest, and in all probability they and several other of the Western States may be classed among the dairy States at no very distant day.

PRODUCTION AND EXPORT OF DAIRY PRODUCTS.

In the short time allotted for the preparation of this paper it has been impossible to gather complete recent statistics of the amount of dairy products produced and exported in the United States. Through the kindness of Mr. B. F. Van Valkenburg, assistant dairy commissioner of the State of New York, we have been furnished with a very complete report of the trade in dairy products of the city of New York for the year ending October 31, 1888, prepared by him for the New York State Dairymen's Association.

These statistics are as follows:

Receipts.

Articles.	Quantity.		Value. Per lb.	Value. Total.
Butter:	*Packages.*	*Pounds.*	*Cents.*	
Eastern	454,063	31,784,410	24.5	$7,787,180.45
Western	1,269,159	63,457,950	22.5	14,278,038.75
Total	1,723,222	95,242,360	....	22,065,219.20
Cheese:	*Boxes.*			
Eastern	1,797,781	98,877,955	10.5	10,382,185.27
Western	80,829	3,637,260	8.5	309,167.10
Transit, for export	152,737	7,636,850	10.	763,685.00
Total	2,031,347	110,152,065	....	11,455,037.37
Milk and cream:	*Cans.*	*Gallons.*		
Milk	5,867,839	58,678,390	....	....
Condensed milk	119,194	1,191,940	....	....
Cream	75,183	751,830	....	....
Total	6,062,216	60,622,160	....	9,652,500.00
Total value of dairy products handled in New York City, during the year ending October 31, 1888				$43,172,756.57

	Packages.
Total receipts of butter for the year ending October 31, 1888	1,733,222
Total receipts of butter for the year ending October 31, 1887	1,662,436
Increase of receipts of butter in 1888 over 1887	70,786
Increase of receipts of cheese in 1888 ever 1887	79,620

Exports of butter and cheese for the year ending October 31, 1888, were as follows:

7,034,500 pounds butter, valued at	$1,266,210.00
76,046,850 pounds cheese, valued at	7,984,919.25
Total value of dairy products exported	9,251,129.25
Value of butter and cheese exported in year ending October 31, 1887	11,000,450.00
Decrease in value of dairy products exported	1,749,321.75

The exports of butter from the port of New York and from all ports in the United States for the past six years has been as follows:

Year.	From New York.	From all United States ports.
	Pounds.	*Pounds.*
1883	18,811,400	22,375,708
1884	15,865,600	21,391,196
1885	14,601,550	19,593,872
1886	11,677,750	14,404,727
1887	9,933,400	12,531,171
1888	7,034,500	*8,483,685

*Ten months.

SUMMARY.

Increase in value of butter handled in New York	$706,231.00
Increase in value of milk and cream handled in New York	152,600.00
Total increase	858,831.00
Decrease in value of cheese handled in New York	734,845.55
Increase in value of dairy products in 1888 over 1887	124,985.45

The amount of oleomargarine handled is so small that no record of it is kept.

One or two facts of significance are shown by the table.

The first, is the constant and rapid decrease in the amount of butter exported amounting in six years to something more than 62 per cent while the total amount of butter handled has been increasing. This shows that we are coming to depend less and less upon foreign countries for a market for our dairy products.

The second fact of significance is in relation to the almost complete extinction of the trade in oleomargarine. The trade in this substance at the time that the national law went into effect, in November, 1886. was enormous; and that the business should have been so completely controlled in so short a time, is largely due to the efforts of an efficient dairy commission, in seeing that the national and State laws were strictly enforced.

While New York city exports about seven-eighths of all the dairy products exported from the United States it is not to be inferred that seven-eighths of all the dairy products produced in the country are handled in New York city. It has been impossible to get accurate statistics of all the large dairy markets; but a late estimate of the Commissioner of Agriculture places the value of all the dairy products of the country for the year 1888, at $380,000,000; while the total value of the dairy products handled in the New York market for the same period as given in the table above was only $43,172,756 or about one-ninth of the whole. However, the proportion between butter, cheese, and milk, in the New York market will probably very nearly hold good in the country as a whole and will give a fair idea of the relative amounts of each produced.

DAIRY CATTLE—KIND, CARE, AND MANAGEMENT.

By far the larger portion of the dairy cows of the United States are what is known as natives or scrubs; that is they are descendants of the cattle that were brought over by the people by whom the country was settled, and have since been bred with little or no regard to ancestry and with more or less admixture of the blood of the more improved breeds. This does not indicate that the improved breeds are not appreciated—for in the United States are more Jerseys than on the Island of Jersey, more Holstein-Friesians than in Holland, and more Short Horns than in England—but that the interest in improved stock which only began within the last fifty or seventy-five years has not yet been able to diffuse itself through the mass and overcome the indifference of the great majority of breeders; for it is a lamentable fact that far too many, perhaps even a majority, of our dairymen make no attempt to increase the product of their cows by judicious selection and breeding, considering that a cow is a cow, no matter how much or how little she may be able to give, and one bull as good as another if he is able to procreate his species.

The following statistics will show something of the average production of the dairy cows through the country:

In the season of 1888, 1,163 creameries and cheese factories in the State of New York were visited by the agents of the State dairy commissioner. These factories received the milk of 407,810 cows (nearly a third of all in the State), and the average product of each cow was 3,034 pounds of milk for the season. This netted the farmer a trifle over 80 cents per hundredweight or gave him a return of about $25 per cow for the season. These factories were open for business about six and one-

half months on the average and but very few of the cows gave any milk before the factory opened in the spring or after it closed in the fall.

The returns furnished by the creamery men to the Secretary of the Nebraska Dairymen's Association and published in the reports of that association for the years 1885, 1886, and 1887 show yields as follows:

For the three seasons an average of nine butter factories, representing 10,760 cows, report an average yearly yield per cow of 76 pounds butter, and two cheese factories, representing 660 cows, report an average yearly yield per cow of 250 pounds cheese. This is equivalent to a yearly milk yield of between 2,300 and 2,500 pounds per cow.

New York is one of the oldest and best developed of the dairy States, and Nebraska is one of the very newest States in which dairying is at all developed, so that the figures given for each represent extremes and will give a very fair idea of average results in the country as a whole.

But it would be manifestly unfair to our best dairymen to rest on a statement of mere average returns. Nor does such a statement show the possibilities of our country or our cattle. As showing something of what is done with good care, good management, and good cattle, the following figures are given.

Mr. C. W. Jennings, of Jefferson County, New York, in a paper read before the New York State Dairymen's Association in December, 1888, gave the results of a careful enumeration of 54 dairies with 890 cows in his county. This report gives the gross returns per cow and the value of the grain ration fed. This last is of great interest as showing the large increase in gross return from a small increase in the grain ration.

Dairies.	Cows.	Gross return per cow.	Value of grain rations per cow.
10	173	$22.60	$3.11
14	234	26.70	3.47
16	284	36.39	4.83
11	145	43.22	6.80
3	54	53.00	11.04

The cows in these herds were a mixture of grades and natives and fairly represented the average dairy.

The breeders of the various herds of improved cattle obtain results much in advance of this. The owners of one of the largest and best known herds of Holstein-Friesians in the country make the following statements in regard to the yields from their herd: Thirty-seven cows and heifers have made records that average 17,064 pounds of milk in one year. Twenty-five cows and heifers have made records that average 18,034 pounds of milk in one year. Nine cows and heifers have made records that average 20,231 pounds of milk in one year. In 1881 the entire herd of mature cows averaged 14,165 pounds of milk. In 1885 the entire herd of mature cows, twenty in number, averaged 15,568 pounds. In 1886 the entire herd of mature cows averaged 17,166 pounds.

As to butter the average records of this same herd are as follows:

	Lbs.	Oz.
100 cows and heifers	17	1
52 cows and heifers	20	10
40 cows and heifers	21	1
31 cows and heifers	22	
22 cows and heifers	23	1
15 cows and heifers	24	
8 3-year old heifers	20	2
23 3-year old heifers	17	
10 2-year old heifers	14	3
38 2-year old heifers	12	

All of the above are for periods of one week; for periods of thirty days, thirteen cows and heifers have made average records of 91 pounds 8 ounces.

A very well known herd of Jerseys is kept in Vermont. The herd numbers over two hundred and for several years the average butter product has been over 300 pounds of butter per cow, including old cows and young heifers.

The enumeration of herds with similar records might be almost indefinitely extended. The above are given merely as well authenticated instances. For individual records the following might be named: 30,000 pounds of milk in a year; 778 pounds of butter in a year; 106 pounds of butter in a month, 112 pounds of milk in a day; 46, 35, and 28 pounds of butter in a week, etc.

As has been said, while a great majority of the dairy cattle have had no attention paid to their breeding, there are a very large number of purely bred cattle belonging to the various dairy breeds and a still larger number of grades of these breeds, that is, cattle that have been produced by crossing the pure-bred bulls on the common cows. An animal is not usually denominated a grade unless it carries at least one-fourth of the improved blood; from that they run up to seven-eighths, fifteen-sixteenths and even higher.

The improved breeds that may be ranked as dairy breeds in the order of number are as follows: Jersey, Holstein-Friesian, Short Horn, Ayrshire, Guernsey, Devon, Red Polled. There are also a small number of representatives of the Brown Swiss, Dutch Belted, and perhaps one or two other breeds.

The Jersey is the most numerous of the dairy breeds. The cow-numbers in the American Jersey Cattle Club Herd Book now exceed 50,000 and there are probably in the neighborhood of 40,000 registered cows and heifers in the country. The number of grades is also very large, and they are among the most useful of the dairy cows of the country.

However much her position may be assailed by the partisans of other breeds, there is no doubt that the Jersey stands at the head of the butter-producing breeds in this country; but she is mainly valuable as a butter producer, and is of course most highly esteemed where butter making is a prime delight. On account of her graceful form, beautiful coloring, and extreme docility, the Jersey is a favorite with the wealthy owners of large country places, who engage in agriculture as a pastime and who care as much for the aesthetic beauty as the practical utility of their live stock.

Some urge against the Jersey that she is lacking in hardiness and constitutional vigor, but she is profitably and successfully kept and reared in the coldest and most rigorous parts of the country and even in the neighboring Dominion of Canada, where the winters are much longer and more severe than they are in the United States. This much seems to be true, however, that the Jersey while not lacking in hardiness or constitutional vigor, appears to be peculiarly sensitive and responsive to both good treatment and neglect.

For some years after they were first imported and up to six or eight years ago, thoroughbred registered Jerseys commanded a very high price. Since then the price has fallen and now good serviceable recorded animals can be bought at from \$100 to \$200 each.

Next in point of numbers to the Jersey comes the Holstein-Friesian. The name Holstein as applied to these cattle is a complete misnomer, but became attached to them when they were first imported and has since stuck to them. They are the large piebald black and white cattle that are imported from the Dutch provinces of North Holland and West Friesland. The first small importation of these cattle was made about the year 1860, and up to 1870 there were but few in the country; since then they have rapidly increased, and there are now probably between 15,000 and 20,000 registered cows and heifers in the country. These cattle are pre-eminently large milk producers, and consequently are favorites in the cheese-making districts,

and in those localities devoted to the production of milk for immediate consumption. The Holstein is an especial favorite with the latter class, because aside from the large quantity of milk produced the well balanced character of its constituents renders it peculiarly satisfactory to the consumer.

The Holstein is a voracious feeder and gives her best returns only where the pastures are rich and luxuriant, or where an intelligent and liberal feeder is willing to supply nutritious food in abundance. It is often urged against the Holstein that her milk is too poor in butter fat; but these cases can almost always be traced to the result of insufficient or injudicious feeding.

Holsteins are large, vigorous, and hardy, and almost always produce large and vigorous calves. In price recorded animals range about with the Jerseys.

I have ranked the Shorthorn third as a dairy breed. Very many dairymen would probably not give them any rank at all as dairy animals; but while the Shorthorn is the most numerous and probably the best of the beef breeds a very large proportion of the butter and cheese of the country is made from the milk of Shorthorn and grade Shorthorn cows. So, while the Shorthorn is the most numerous of all the breeds and undoubtedly first of the beef breeds, I rank her third of the dairy breeds. Throughout all the great central dairy region (the second group of States in the table) Shorthorns and their grades probably outnumber all other breeds and their grades as five to one.

The Shorthorn in her English home is of two grades, a dairy animal and a beef-maker. As we find them in the United States to-day the better class of dairy Shorthorns give a fair amount of milk of good quality. They are large, hardy, and docile, and the numerous grades, when bred to either Holstein or Jersey bulls, produce a very excellent and extremely useful type of dairy cows.

The Ayrshire is a small, hardy, active cow, chiefly noted as a milk producer. Up to ten or twelve years ago she was a great favorite in the cheese-producing districts of New York and New England. Since then she has been partially supplanted by the Holsteins, and partly by Jerseys and Guernseys. Still, she will thrive and give a fair return on pastures and with treatment under which her Dutch competitor would be totally unprofitable; and on account of her activity and small size is a useful animal in the mountainous and more unfertile districts.

Although the Ayrshire has an especially well-formed udder, she has been unpopular with many on account of the extremely small size of her teats. The more progressive of the Ayrshire breeders are now paying more attention to docility, size, and large teats, and good results can already be seen in several herds.

The Guernsey, like her near relative, the Jersey, is a butter-producer, and so like her in nearly all respects that what was said for one will very nearly apply to the other. The Guernsey is slightly the larger, and by many is considered to be hardier and to yield a more highly colored butter. For some unaccountable reason they have never been as popular as the Jersey, and they are only found in small numbers. There are about 3,000 recorded in the herd-book of the American Guernsey Cattle Club.

The sprightly, tidy, ruby-colored Devon is a favorite of the farmer who lives in hilly or mountainous districts. In return for rather scant fare she will yield a small amount of rich milk and a small carcass of beef of excellent quality. The steers make the very best of working oxen, being intelligent, active, and docile.

The other breeds have not as yet been imported in sufficient numbers to definitely establish their claims on popular favor.

Throughout the dairy regions of the United States the pastures can not be turned upon before the 1st of May, and in many portions not until the middle, or after. It is a general custom among dairymen to have the calves dropped during April; the cows then go upon grass in the flush of their flow of milk. Ordinarily they receive no feed except the grass that they crop, and during all the early part of the

season do very well on this alone; but in the latter part of summer they begin to fail and give less and less until they go dry in November or early in December. A few of the better class of farmers will supplement their pastures in the fall with fodder corn; but very few feed any grain ration to their cows during the summer. Under this system the cows are dry from four to five months. This is the ordinary practice of the farmer, especially in the cheese-making districts and the districts where butter is made on the farm in private dairies. The cheese factories ordinarily only run from six to seven months. Under this system the cows only receive a small amount of grain and that is mainly corn meal. Almost all variations from this system are in the line of improvement and will be treated somewhat in detail,

The dairymen who furnish milk for immediate consumption aim to make an equal quantity as near as possible through the whole year, and for this purpose breed their cows so that calves are dropped in every month. The cows are well fed from the time that they calve, and so do not go dry more than a month or six weeks. Cows that are inclined to go dry too soon or that do not give a satisfactory amount of milk are quickly fattened and sent to the butcher. These dairymen are, of course, found in the largest numbers near the cities and large towns where the land is high priced and do not as a rule raise their own cows, but depend on such as they can buy. Most dairymen of this class are intelligent and liberal feeders. They aim to keep as many cows as possible on their farms and so raise but very little grain, but they do raise a large part of the rough fodder.

Indian corn is largely raised for fodder, and its growth and preservation has undergone a marked revolution within the past ten years. Formerly it was the almost universal custom to sow it broadcast so thickly that nothing but leaves and stalks were produced. In this way it was possible to grow a large amount of fodder per acre, but it was difficult to handle, difficult to cure, and unsatisfactory when fed. The first step toward improvement was the introduction of the silo, now about twelve years ago, but the principles governing the preservation of green corn in silos were not well understood, and the first ensilage did not give, generally, satisfactory results. It was supposed that it was necessary to weight the silo heavily, and this made necessary heavy side walls and needless expense. It was also recommended to cut the corn at or soon after blossoming, when it was still green and immature, and hurry it from the field to the silo as rapidly as possible, and as the corn was still grown so thickly that no grain was produced, it is no wonder that the ensilage was sour and unsatisfactory. Within the last few years there has been a marked change, and the practice of the most successful farmers is about as follows: The walls of the silo are only made sufficiently strong to sustain the weight of material that they are to hold. They are often made of wood. Great care is taken that they shall be as nearly as possible air-tight. This is secured by double boarding on each side of the joists, with building paper between the boards. The corn is sown thinly so that there may be a good development of grain, and it is allowed to stand until the grain is mature. It is then cut, allowed to wilt in the field, and taken to the silo. The silo is filled slowly. After it is filled to the depth of 3 or 4 feet filling is suspended until the mass already put in has reached a temperature of 120°, when another portion is added, allowed to heat up, and so on until the filling is completed. By filling slowly in this way and allowing fermentation to proceed to a certain degree, carbonic acid is formed, and being heavier than air, drives it out and effectually excludes it from the silo. When the silo is full it is covered tightly with building paper and matched boards, or in some cases even with straw, so that the air may be kept out and is not weighted at all. In this way it has been found possible to preserve corn with but a minimum development of acid and to secure a valuable, palatable and nutritious food.

But to come back to our milk-dairy farmers. While they raise but little grain,

and that chiefly Indian corn, they feed grain heavily, especially in the winter. From their proximity to the cities brewers' grains are a cheap food, and they have a very marked influence on the flow of milk. They are consequently fed fresh, dried, or preserved in silos in as large quantities as are considered safe; but from their bad effect on the quality of the milk and the health of the cows, when fed to excess, have always to be used with caution. Large quantities of wheat bran, linseed-oil meal, and cottonseed oil meal are also used. Roots are not used to any great extent either by the milk farmers or by any other class of dairymen in the United States. The great objection to them is the cost of raising, and ensilage as furnishing a succulent food in the winter time very nearly fills their place,

A large number of the butter dairymen are beginning to learn that the winter is the most profitable season in which to make butter. In making winter butter the cows are bred to drop their calves in September and October. The cows are well fed during the fall and go into winter quarters with a full flow of milk. With care and good feed the flow of milk is kept up during the winter and the cows go on pasture in the spring in good condition, and will give nearly as much milk as a cow that has lately calved, during all the early part of the season. They go dry during July and August and calve again in September, and are ready for another season's work. Some of the advantages of this system are:

The cows are dry at the period of the year when flies and other insects are most troublesome, when it is most difficult to make butter of a good quality, and when butter brings the lowest price in market.

Numerous experiments have shown that a cow calving in September or October will give more milk and make more butter in the course of a year than will one calving in April or May.

The calves having an abundance of skim milk during the winter are ready when spring comes to make a vigorous growth, and will attain a better development at a year old than will calves born in the spring.

The labor is more evenly distributed through the year, and, last but not least, a large part of the butter product of the year is made in the months when fresh butter is scarce and commands a high price.

But winter dairying requires something more than ordinary methods in order to insure success. Some of the more important requisites are given below:

Intelligent and liberal feeding. Not only must the cows be well fed but properly fed. It is easier to make a cow grow fat in the winter than it is to make her give milk. Winter dairymen have found that it is important that their cows must have plenty of nitrogenous food.

The animals must be comfortably housed, not only at night but in all but the very pleasantest weather. Many of the best of the winter dairymen are finding it profitable to partially warm the water for their cows.

Watchfulness and painstaking care on the part of the owner is essential. A man will not make a success of dairying in the winter unless he is willing to sacrifice his own comfort, when occasion demands, to the welfare of his cattle. The feed and management during the winter does not differ greatly from that given by those who make milk for market. A large number of the winter-butter dairymen are in the great central dairy region and raise large quantities of corn, and being close to the large flouring mills of the West depend largely upon wheat bran and corn meal for their grain ration. These with corn fodder, ensilage, and clover and timothy hay, are the great staple fodders, and it would indeed be hard to find better foundations for economical rations for butter production.

It is in attention to what are often called minor matters of detail that our better dairymen obtain much of their success. Thus all good dairymen are extremely particular that the water supplied to their cows shall be convenient, abundant, and pure, and are careful that it shall be supplied from either wells, springs, or running streams.

The importance of an abundant and regular supply of salt is not understood by so many; but a well-known and painstaking professor in one of the best of our agricultural colleges has shown as the result of experiment that when the cows are not salted regularly there was a loss of 14½ per cent in the quantity of the milk, that the milk when set at 60° F. became sour 24 hours sooner, and that the cream took one-third longer time in churning.

The bad effects of all kinds of excitement on the cow so far as milk and butter product is concerned, it is to be feared, are well understood by many more dairymen than are careful to see that their cows are kept as free as possible from all disturbing influences. However, no self-respecting dairymen will allow his cows to be driven by dogs, or will allow cursing or blows in the stable and yards.

One reason for the large number of inferior dairy cows is undoubtedly the lack of attention paid to the rearing of dairy stock. Very many dairymen do not pretend to raise their own cows, but depend upon purchases to keep up their herds. The result of this is that the cows are born and brought up on the rough, hilly back farms by men who are not enterprising enough to make dairymen. Beside the lack of attention to breeding, these animals are allowed to subsist as best they can on coarse fodder for the first two years of their life, and when, having brought forth a calf, they are sold as milch cows to some dairyman, it is no wonder that 3,000 pounds is about the measure of their yearly capacity for milk.

The better class of dairymen raise their own cows and are particular as to their care and treatment from calfhood up. The young calf is taken from the mother when about twenty-four hours old. Many do not allow the calf to draw the milk from the cow but once, and some do not allow the calf to suck at all. After the calf is taken from the cow it is immediately taught to drink, and is fed new milk from the cow for four to six weeks. After that it is fed sweet skimmed milk until it is from four to six months old. As soon as it shows any inclination for dry food, which it will do at from three to four weeks old, it is supplied with whole oats or wheat bran, in which a very little linseed-oil meal has been mixed, and a little bright clover hay is placed where the calf may nibble at it. In this way it is kept growing during its first summer. The feed for the first winter is largely clover hay, if it is at hand, or, if not, oat straw or corn fodder, supplemented with a grain ration which is rich in nitrogenous matters, as oats, barley, wheat bran, linseed or cotton-seed oil meal. During the second summer the young heifers run on pasture without grain, and in the second winter, if good coarse fodder is at hand, it is not usual to feed grain.

The young heifer is expected to drop her first calf when two years old, and regularly each year after that. Some of the best dairymen vary this practice by having the first calf dropped when the heifer is two and a half years old and the second when she is four years old, thus giving a long period of milking between the first and second calf. They claim that by a long period of milking after the first calf the "milking habit" is more firmly established and a better dairy animal results.

BUTTER-MAKING.

Below is given the report of the butter committee of one of the "butter conferences," held by the New York State Dairymen's Association, during the past year. It is given as the practice recommended by a committee of the best butter-makers of the State:

"It is important that the cows should be adapted to the purpose. The feed should contain the proper elements for making butter. As proper feed we recommend a mixture of bran, corn, oats, mill-feed, and peas, with a small amount of linseed and cotton-seed meal. This food should be mixed in proper proportions. The cows should be fed and milked with regularity. The water should be pure,

the stables well ventilated, the cows kept clean, and the most careful and painstaking care given in all places as to cleanliness. To leave the milk pails unwashed over night, even though no dirt is added, and they may be as clean, apparently, as they were when used the night before, is a dangerous mistake. During the night incipient putrefaction may take place in the milk left in them, and these germs will affect the milk put in them and its products. There is something more than cleanliness required in the dairy; there must be the purifying effects of boiling water. The utensils should, therefore, always be scalded immediately after being used and kept perfectly clean and sweet. The cows should be milked regularly at the same hours each day and as nearly as possible at intervals of twelve hours; and always, if possible, by the same person. As soon as the milk is drawn it should be set for the cream. It should always be set in deep cans in cold water. The importance of immediate cooling for the milk is not enough appreciated, and the sooner it is cooled and well ventilated at the same time the better it will be for any use. For butter, excessive cooling is not recommended. To cool the milk down to 45° F. is about right. Cream will rise sooner with a lower temperature, but it is doubtful if the product is so good as when the cream is raised at a temperature of about 45° F., or a little less. On no account should the temperature go below 40° F. The cream from milk cooled down to these low temperatures is thin and green, or immature, and must be given time to ripen or to come to perfection. The cream should be raised within twenty-four hours, after which it should be kept at a temperature of 45° F. until the ripening process begins. The surroundings must be pure, free from taints, and the cream stirred frequently that it may become well oxidized. This is a part, and an important part, of the ripening process, during which the full properties of perfect cream are developed. By 'ripening' cream is meant a full aeration or oxidizing, which produces the best flavor in the resulting butter. To bring it to the highest degree of perfection in this respect it should be stirred occasionally and kept in a cool and even atmosphere (say 45° F. as a standard) for at least twenty-four hours after the last batch of cream has been put in. This is done to insure uniformity of the cream in its ripeness—to give time for it all to ripen. At the end of the twenty-four hours it may be warmed up to about 60° F., when acidity will develop, and it is fit or in the best condition to churn. This is a rule or a good law. Circumstances may modify the conditions or make radical changes, such as cool weather, hot, murky weather, thunder storms, food, pure water, etc., but the nearer the rule can be observed the better will be the butter. Sourness is not ripeness. Sourness does not get the most or the best butter if it is carried beyond the perfect point, which is simply "acid." A continuation of acidity will lessen the amount of butter and make a low quality. Cream of different degrees of acidity will not churn evenly, hence there must be a time when to stop adding fresh cream, and this time is designated 'the beginning of the ripening process.' After this, ripening should go on for twenty-four hours, and it is slower and more complete in a cool temperature than it is in a warm one, where the cream speedily gets too sour and must be churned or lose its flavor and quantity of butter.

"When the cream is completely and properly ripened churn, at a temperature varying from 62° to 68° F., according to the season and the surrounding temperature. When the butter has come about the size of kernels of wheat, draw off the buttermilk and add cold water. Agitate the churn gently, then draw off the water, and repeat this process until the water runs clear. Take the butter out carefully and weigh it. Place it on the worker and salt it one ounce to the pound. Work enough to thoroughly incorporate the salt and pack the butter immediately."

Butter is made both on the farm, in private dairies, and in creameries or butter factories. The creamery system, as it is called, was first introduced about fifteen years ago, and has since spread rapidly. Its chief advantages are that a

better and more uniform quality of butter can be made, and the farm is relieved of a large amount of drudgery that usually fell upon the women.

Creameries are run either upon the "gathered cream" or "whole milk" plans. The former are by far the most numerous. Under this system wagons are sent by the creamery to the houses of the patrons, and the cream, which is always raised in deep cans set in cold water, is skimmed by the driver. The cream of each patron is either weighed or measured and a small sample taken to be tested. Formerly a certain number of cubic inches of cream were taken for a pound of butter, and the patron paid accordingly, but it was found that cream varied so greatly in its percentage of butter fat, that while an average could be so closely approximated that the creamery would suffer no loss, great injustice would be done individual patrons. To correct this injustice several systems of testing were devised. They all depend upon the principle of quickly separating the fat of the milk or cream into oil and measuring the amount of oil obtained from a given amount of milk. In nearly all the fat is first separated by churning and then converted to oil by heating in warm water, though in a method lately devised by Prof. Short, of the Wisconsin Agricultural Experiment Station, the fat is separated by boiling the cream first with strong alkali and then with acid. There are several of these methods that give results so nearly accurate that nearly all the creameries have adopted some one of them and pay for their cream on the basis of its richness in butter fat as shown by the "test."

The cream having been brought to the creamery all collected in one day is poured together in a large vat and ripened, after which it is churned and worked by power, all the details being carried out with the greatest attention to cleanliness, temperature, and all other conditions that may affect the quality of the butter.

The "whole milk" creameries only differ from the "gathered cream" in that the milk is brought to the creamery by the patron and the cream separated there either by deep setting in cold water or by the centrifugal. The latter is the more common practice in these creameries. These creameries have an advantage over the "gathered cream" system in being able to secure more uniform and better conditions before the cream is separated, but the latter have the advantage in that the skimmed milk is left on the farm, where it is an important article of food for swine and young stock.

Creameries are either coöperative or proprietary. In the former case the patrons own the plant, hire the butter-makers, attend to the marketing, and divide the net proceeds among themselves in proportion to the amount of cream furnished. In the latter case the creamery is the property of an individual or stock company and the cream is bought outright from the patrons. Both systems are in successful operation, but there are probably more proprietary than coöperative creameries.

It is perfectly possible to make the best of butter in private dairies, and the very choicest butter made in the country is so made; but there are only a very few such dairies. Most of the private dairies are small and the churnings are small. Moreover, since it is impossible to control the conditions each churning makes a different quality of butter, and each farmer makes a different quality of butter, and when the whole is thrown on the market brings a low price fully as much from the diversity of its character as from lack of quality. Another reason for the low price of dairy butter comes from the fact that a large portion of it reaches the market through the medium of the country storekeeper, and while it may be of good or at least fair quality when it leaves the farm, it suffers so much from too long keeping in the various "groceries" that it is sadly degenerated long before it reaches the consumer.

There is a considerable quantity of butter of a fair quality made in private dairies, especially in localities that are remote from markets and still specially adapted to dairying. In these places it is still the custom to set the milk in shallow pans in

the open air at a temperature of nearly 60° F. as it is possible to obtain. It is also customary to pack the butter and sell the whole product of the dairy for the season at one time in the fall. These regions are the source of the best private dairy butter in the market, but even here the tendency is toward the adoption of the creamery system.

The demand of the American market is for fresh butter. This has stimulated both the growth of the creamery system and winter dairying. The creameries, making large quantities of butter, can and do ship butter in quantity as fast as made, so that it reaches the consumer as fresh as possible. For this purpose refrigerator cars constructed specially for the purpose are almost exclusively used, and in them butter can be shipped long distances in good condition. The introduction of refrigerator cars has extended the dairy, and especially the butter industry, over a large extent of territory that without them could not profitably engage in these industries.

CHEESE MAKING.

The growth of the cheese industry in the United States dates from the introduction of the cheese factory, a little less than thirty years ago. Up to this time all cheese had been made in private dairies, and what has been said in regard to the quality of private dairy butter was true, in an even greater degree, of the private dairy cheese. At the present time practically all of the cheese is made in cheese factories, and a very large proportion of them are run on the coöperative plan.

So long as a full-cream cheese was made our cheese enjoyed an excellent reputation not only at home but abroad, but the practice of skimming has so injured the reputation of our cheese, that, seeing their folly, our cheese makers are now urging a return to the making of only full-cream cheese.

By far the larger part of the cheese is of the variety known as the American Cheddar. It is a cylindrical flat cheese of from 40 to 60 pounds weight, about 18 inches in diameter and 6 inches thick. There are also a considerable number of a variety known as "Young Americas" made. These are made of the same general shape, but of such size that five can be packed in the same sized box as one of the ordinary kind. The fancy varieties of cheese are not made to any great extent, but Limburger, Stilton, Edam, Pineapple, and Neufchâtel, Swiss, or cream cheese are all made in a few factories in isolated localities. Below is given the method taught by the cheese instructors of the New York State Dairy Commission. It is called the "Modified Cheddar" process, and is essentially the practice of the best cheese makers throughout the country.

The milk is placed in the vat and heated from 82° to 84° F. in the warm weather of the summer, and to 86° F. in the cool weather of the fall. If color is to be used, it should be stirred in thoroughly before adding the rennet.

Sufficient rennet is used to coagulate the milk in from twenty to twenty-five minutes and bring the curd into a condition fit to cut in from fifty minutes to one hour.

The rennet extract, or powder, on account of uniformity of strength, is considered safest to use and there is not the liability to taints that there is when makers prepare their own rennet in tubs, jars, etc.

The curd is then cut lengthwise of the vat with a horizontal knife.

The cutting is begun as soon as the curd will cleave clean from the sides of the vat, or break clean before the finger, or cut without breaking before the knife.

It is then cut lengthwise and crosswise with a perpendicular knife.

The cutting should all be done as soon as possible after beginning, as it is claimed that if the curd is in proper condition, or, in technical language, if it is just hard enough to begin on, the quicker it is cut the less waste there will be.

If the curd is too hard the knife will break off fine particles which are lost in the whey.

When the cutting is completed the curd is gently agitated for about fifteen minutes.

The heat is then slowly applied up to 90° F., then more rapidly until the highest point is reached, 98° F., or blood heat. In order to preserve the most fat observe the temperature which will cause the complete expulsion of the whey.

Great care should be taken during the heating process to stir so thoroughly that not any part of the curd will become overheated by resting too long upon the hot tin, because this would melt the fat and partially destroy the activity of the rennet in that portion of the curd.

Keep the curd agitated till it reaches the stage of contraction at which it will not pack.

The vat is then covered with a cloth, in order to retain an equable heat through all parts of the mass, stirring under the cover occasionally to keep the curd loose.

The curd is allowed to remain in this condition until sufficient acid is developed to show a quarter of an inch of fine thread by the hot-iron test.

The whey is then all drawn off and the curd packed about equally on the two sides of the vat, leaving a clear space in the center, for the purpose of draining.

After a few minutes, and for the same purpose, the layers of curd are cut lengthwise through their centers and again crosswise into strips or blocks about 12 inches long; the center strips are turned bottom side up and placed upon the outside strips; keep well covered with a cloth.

In ten minutes or so the two piles are turned over and placed in the center of the vat, one on the top of the other, forming one row of four layers.

Up to this point the chief object of the process has been to separate the whey from the curd, but from this point out the process is distinctly one of digestion or "assimilation."

The pile is left lying in this way for a time, and as it flattens out it is again cut and doubled up and kept as close as possible in order to retain the temperature.

It is important that during these manipulations the temperature be kept up to about 98° F., as this is the most favorable for the maturing of the curd, and to have it assume that flaky appearance and velvety feeling, which it must do in order to be a perfect curd.

If, from any cause (as tainted milk, etc.), there is a development of gas at this stage, the packing must be continued until the gas cells become flattened and the curd appears solid and shows about the same texture as a perfect curd.

The production of lactic acid fermentation is important here to overcome putrefactive fermentation, which is very liable to develop, especially in hot weather, and which is very destructive to the flavor, quality, and firmness of the cheese.

When the curd has reached the proper stage of digestion, it can be torn into strings and "ribbons" the whole length of the piece, like the inner bark of an elm tree, and the torn surface has a fibrilated appearance like the cooked flesh on a chicken's breast.

The curd is now cut up into strips, spread out in the bottom of the vat, allowed to cool down to from 88° to 85° F., and then ground. The salt is applied as the curd passes through the mill. The salt is then stirred in and the curd is reground and put to press. The pressure must be slight and applied gradually till the whey is pressed out and the rind is formed. If it is left in the press from 12 to 18 hours, it will retain its form better and be more solid than if pressed in less time.

The above method is based upon the use of pure milk. To make a close meaty cheese from floating curds, it is necessary to modify the process. In this case we use the same amount of rennet cut a little finer and stir from 10 to 15 minutes without steam.

Apply the steam slowly at first, taking plenty of time for the temperature to rise to the highest point needed (100° F.). The curd must not be allowed to pack on the bottom of the vat. Use every means possible to drive out the surplus whey.

When the acid shows one-half inch on the hot iron, draw off all the whey, pack the curd in as small a space as possible, cover the vat so as to retain the heat, cut the curd into strips often, and repack.

When the gas has fully developed, run the curd through the mill, repack it, and keep it covered so as to retain the heat, letting in dry steam under the cover to warm the curd, if necessary.

When the gas-holes become flattened and the curd appears close and solid and shows about the same texture as one made from good milk, cut it up into strips and spread it out thin over the vat. Then allow it to cool to about 85° F., grind, salt the same as for good curd, and put it to press. Allow it to remain in press as long as your time will permit, at least eighteen hours.

Prof. J. W. Robertson, lecturer on dairy husbandry, in Cornell University, and a recognized dairy expert, has issued a series of more than a hundred "Hints to Cheese Makers." In the main they cover the process given above, but some of them supplement and explain points of that process and are given below:

Overripe or acid milk may with advantage be set as high as 96°F., according to the degree of its ripeness.

In the use of coloring the annotto extract should be diluted to the extent of one gallon of water to every vat full of milk and then thoroughly stirred in.

Pure rennet extract or powder of known strength is indispensable. The quantity used should be regulated according to the condition of the milk.

Rennet should be diluted to the volume of at least one gallon of liquid for every vat before being added to the milk. It should be thoroughly mixed by vigorous stirring, otherwise coagulation will be very imperfect.

To perfectly coagulate the milk from fresh-calved cows, more rennet is required than later in the milking season.

The more rennet there is used the more moisture will there be retained in the cheese under similar conditions of making.

The more moisture there is retained in the cheese the more quickly will it cure under equal condition of temperature and atmosphere,

Pains should be taken to make the curd particles so dry, before the development of acid is perceptible, that after being pressed in the hand and released they fall apart when slightly disturbed.

The presence of too much moisture in the curd while the acid is developing is the cause of tenderness of body and pastiness in cheese.

If the temperature be allowed to fall below 92° F., the development of acid is retarded and excessive moisture is retained in the curd during its development.

The conditions of the curd, as to when ready for cutting and salting, are best ascertained by the use of the senses. The usual order of reliability for that purpose is by touch, smell, taste, and appearance.

The proper degree of change has taken place when the curd feels mellow, velvety, and greasy; smells like new-made butter from sour cream; tastes aromatic rather than sour, and shows a texture passing from the flaky or leafy into the stringy and fibrous.

One pound and three-quarters of pure salt per 1,000 pounds of milk is a maximum quantity for April and early May cheese. From two to two and three-quarters pounds is the range for summer use on fairly dried curds, and from three to three and one-half pounds during October and November.

Where extra rennet has been used, or where the curd is sloppy, a corresponding increase of salt should be applied.

One important action of salt is to dry the curd and cheese, and thus retard the curing.

All cheese should be turned in the hoops in the morning to give finish to the shape and body.

No cheese should be taken to the curing room till the shape is true and the edges well made.

The cheese should be turned on the shelves once a day till at least three weeks old.

The curing is effected by fermentation, while heat up to 70° F. makes a favorable condition and cold under 60° F. an unfavorable condition for its operation.

A temperature of from 70° to 75° F. should be maintained for curing spring cheese, while 65° to 70° F. is the best range of temperature for the curing of summer and fall cheese.

DAIRYMEN'S ASSOCIATION AND DAIRY EDUCATION.

The education of the farmer and dairyman in the better dairy practices has been very largely brought about by the influence of the dairymen's associations. The pioneer and parent of these was the American Dairymen's Association. It was established in 1864, soon after associated cheese-making had been found to be successful. At the first meeting there were representatives from sixty-nine cheese factories present. At the next meeting the attendance was largely increased, and for several years there was a steady growth, the interest and attendance becoming truly national in character. Some of the best of our dairy literature is found in the published reports and proceedings of this association. As offspring of the American Dairymen's Association various State associations sprung up, and, being more local in character, gradually supplanted the parent association, and it was finally disbanded in 1882. The State associations continue to prosecute the work with vigor, and in their reports and conventions are building up a literature not second to that of the parent society. There are now flourishing organizations in the States of New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania, Michigan, Illinois, Wisconsin, Iowa, and Nebraska.

There are no schools especially established to give instruction or practice in the various operations of dairy industry, though a movement is now on foot in New York looking to the establishment of such schools. Several of the State agricultural colleges, founded on the land-grant act of 1862, give special attention to this important branch of agricultural industry. This is especially true of Cornell University, at Ithaca, N. Y., the University of Wisconsin, at Madison, Wis., and the State Agricultural College, at Starkville, Miss.

Last, but not least, of the means of dairy instruction is the system of farmers' institutes now established in many of the States. Under this system trained lecturers are sent at State expense to attend meetings of the farmers and instruct them orally and by illustration in all the practices of improved agriculture. These meetings have been the means in the last few years of disseminating many new ideas and practices with much resultant good to the farmer and dairyman. And these farmers' institutes have been best attended and have done the most good in the States where dairying is a leading industry.

CHAPTER XV.

THE COMPARATIVE COMPOSITION OF AMERICAN AND EUROPEAN BEEF.

By CHAS. D. WOODS.

A comparison of the analyses of American and European beef as made by prominent chemists reveals the fact that there is a very important difference in the composition of this article of food as it is produced on the two continents. The following table, which has been compiled from König's Nahrungsmittel, and from the analyses of Prof. W. O. Atwater, of Wesleyan University, Connecticut, contains the greater part of the reliable chemical investigation of this subject.

	Water.	Protein.	Fats.	Ash.
Neck, medium fat, American:				
First cut	60.64	18.26	20.15	0.95
Second cut	64.48	19.96	14.49	1.07
Third cut	61.00	20.21	17.74	1.05
Average of 3 samples	62.04	19.48	17.46	1.02
Total, taking weights into account	61.97	19.25	17.77	1.01
Neck, European:				
Medium fat	70.35	21.38	6.86	1.41
Lean	77.50	20.40	0.90	1.20
Hip sirloin:				
Medium fat, American	58.86	17.26	22.94	0.94
	56.05	16.15	26.90	0.90
Average of 2 samples	57.46	16.70	24.92	0.92
Very fat, European	63.40	18.80	16.70	1.10
Medium fat, European	71.20	18.19	9.86	0.75
Lean, European	77.40	20.30	1.10	1.20
Small end sirloin, medium fat:				
American	60.68	16.92	21.53	0.87
European	70.25	23.88	3.85	2.02
Shoulder steak, medium fat:				
American	65.33	19.40	14.43	0.84
European	70.83	24.64	3.08	1.45
Shoulder clod medium fat:				
American	63.97	18.90	16.12	1.01
	66.61	20.66	11.54	1.19
Average of 2 samples	65.29	19.78	13.83	1.10
European	75.29	17.33	6.25	1.13
Rump:				
Medium fat, American	40.23	14.65	44.34	0.78
	56.28	16.07	26.79	0.86
Average of 2 samples	48.26	15.36	35.56	0.82
Medium fat, European	74.60	19.05	5.42	0.93
Round, medium fat, American:				
First cut	66.04	19.48	13.40	1.08
Second cut	69.53	20.57	8.57	1.33
Average of 2 samples	67.79	20.02	10.99	1.20
Total, taking weights into account	66.76	19.71	12.40	1.13
Round, medium fat, European	70.90	24.21	4.11	0.78
Average of 32 samples medium fat, American	56.58	17.59	24.86	0.97
Whole side, taking weights into account, medium fat, American	52.43	16.44	30.20	0.93
Whole side without kidney fat	54.77	17.20	27.07	0.96
Very fat, average of 7 samples, European	55.42	17.12	26.38	1.08
Medium fat, average of 21 samples, European	72.25	21.39	5.19	1.17
Lean, average of 9 samples, European	76.71	20.61	1.50	1.18

An examination of these figures shows that American beef constantly contains a larger proportion of fat, a slightly smaller proportion of protein, and much less water than similar specimens of European beef. These conclusions are shown more clearly by placing side by side the analyses of similar specimens from the two continents, as follows:

	Water.	Protein.	Fats.	Ash.
Neck, medium fat:				
American	61.97	19.25	17.77	1.01
European	70.35	21.38	6.86	1.41
Hip sirloin, medium fat:				
American	57.46	16.70	24.92	0.92
European	71.20	18.19	9.86	0.75
Small end sirloin, medium fat:				
American	60.68	16.92	21.53	0.87
European	70.25	23.88	3.85	2.02
Shoulder steak, medium fat:				
American	65.33	19.40	14.43	0.84
European	70.83	24.64	3.08	1.45
Shoulder clod, medium fat:				
American	65.29	19.78	13.83	1.10
European	75.29	17.33	6.25	1.13
Rump, medium fat:				
American	48.26	15.36	35.56	0.82
European	74.60	19.05	5.42	0.93
Total round, medium fat:				
American	66.76	19.71	12.40	1.13
European	70.90	24.21	4.11	0.78
Whole side, without kidney fat, American	54.77	17.20	27.07	0.96
Medium fat, average of 21 samples, European	27.25	21.39	5.19	1.17

A number of the most conspicuous examples of this difference has been shown on the chart which forms a part of the exhibit of animal products.

A comparison of the fuel or heat-producing value of such similar specimens of American and European beef makes the difference even more marked than would be suspected by a casual study of the figures reached by the analyses above referred to. Thus the fuel value of the similar cuts has been calculated as follows:

	Calories in 1 kilo.
Neck, medium fat:	
American	2442
European	1515
Hip sirloin, medium fat:	
American	3002
European	1623
Small end sirloin, medium fat:	
American	2696
European	1337
Shoulder steak, medium fat:	
American	2137
European	1297
Shoulder clod, medium fat:	
American	2097
European	1292
Rump, medium fat:	
American	3938
European	1285

The fuel value of American beef is, in round numbers, from 1½ to 3 times that of European beef as shown by these analyses.

The importance of these facts is still more apparent when we consider that the analyses of the average dietaries of European workmen shows that these are poor in the very principle which is most abundant in American beef. In other words, it is well established that an increase in the amount of fats eaten by the laboring classes of Europe is needed to make their ration complete and to give them the strength needed for arduous labor. The American beef, therefore, not only supplies to the natives of Europe a cheap, wholesome, and in every way excellent article of food, but it gives the chemical principles which are usually deficient in the food as now supplied, and for this reason, if no other, it should become an important article of commerce.

CHAPTER XVI.

LEATHER PRODUCTION OF AMERICA.

By ISAAC H. BAILEY.

There were 11,773,171 hides and 19,936,658 skins tanned in the United States in 1880; 23,812 men were employed in tanning and 10,885 in currying the leather. Value of product tanned, $113,348,336; of curried leather, $71,351,297. The production for 1888 may be estimated at from 25 to 30 per cent above that of 1880.

The exports of leather and leather manufactures for the past five years have been:

1884	$8,305,779
1885	9,692,408
1886	8,737,682
1887	10,436,138
1888	9,583,411

The leather is tanned by placing the sides in vats filled with liquors extracted from bark and agitating them at frequent intervals. Light sides are sometimes sewed in bags and the tan liquors forced gently through the pores. This does not include "oil and alum tanned," which is simply tawed leather.

The varieties of leather made in the United States from domestic hides and skins with methods of tanning and finishing are:

OAK SOLE

is made from green salted or dry domestic hides; the former chiefly. Hides are soaked in water from one to three days, fleshed, then put in limes, and wheeled from one pit to another from three to five days. The limes are cold and the process loosens the hair. The hides are taken out, unhaired over the beam, washed in pure water, and worked on the grain to remove superfluous lime, then handled in weak sour liquors for three weeks, then laid away in fresh oak liquors and ground oak bark for three or four months, then washed, oiled, and dried, dampened, and laid in piles to sammy, and rolled.

If scoured backs are made, the hide after tanning, or when partially tanned, is trimmed and scoured on the grain. This leather is used mainly for the soles of fine shoes. Backs are tanned of whole hides, from which the heads and bellies are trimmed off when partially finished. The scoured backs are the highest-priced sole leather made.

UNION SOLE LEATHER

is made almost entirely from green salted hides. It is tanned with liquors made of oak and hemlock bark, the latter largely predominating. The hides are soaked from one to three days, fleshed, put in lime four or five days, unhaired, put in clean water, taken out and worked on the grain, then handled in weak sour hemlock liquors about three weeks, then laid away in fresh hemlock liquors and bark three to four months, but dusted down in the "layways" with plenty of oak bark ground

fine, taken out, washed, oiled, dried, dampened, and rolled. Bellies are struck through and trimmed off after about six weeks in tan. Heads are cut off from the hides and usually tanned separate.

Union leather is popular in this country. The production of it increases steadily. It is used largely for soles of women's shoes. Heads and bellies cut from it are exported in considerable quantities.

HEMLOCK SLAUGHTER SOLE LEATHER.

Tanned without acid.—Hides are split, soaked, fleshed, limed two days, handled a day in hot water, and then unhaired, and taken to weak sour liquors, where they are handled two weeks, then laid away in liquors of 12 per cent strength two weeks, then changed to fresh liquors of 16 per cent for three weeks, then to liquors of 18 or 20 per cent for a month, and then to liquors of 25 per cent, and they lie there a month or more, then taken out, washed, oiled, hung to dry, dampened, sammied, and rolled. This leather is bought and sold by the dealers in findings and shoemakers' materials. It is useful for custom work and cobbling. To some extent it is exported to northern Europe. It is the highest-priced hemlock leather made here.

Acid leather.—Hides are split down the back, then soaked one to three days, fleshed, put in lime two days, handled in hot water one day, unhaired, washed, and hung in vats on sticks in weak coloring liquor an hour, taken out and hung in vitriol vats forty-eight hours in a weak solution of sulphuric acid and water; then handled in sour liquor two weeks, laid away in fresh hemlock liquors three to five months, or handled in the extract; then oiled, dried, dampened, and rolled. This sole leather is exported to some extent. Most of the leather sent abroad is tanned with acids. At home it is used for bottoming shoes which are designed for service rather than for show.

HEMLOCK SOLE FROM DRY HIDES.

Nonacid.—Hides are soaked two weeks, split, softened in a hide mill, hung in sweat pits five to seven days to unhair, taken out, worked in hide mill to unhair, also over the beam; then fleshed, handled in weak sour liquors ten days, then put in sweet hemlock liquors, say, of 12 per cent two weeks, then 16 per cent three weeks, then 18 per cent four weeks, and in 25 per cent a month; then washed, oiled, hung to dry, dampened, sammied, and rolled. This leather is used in all kinds of cheap shoes. It is soft and pliable, and works well under the sole-sewing machine. There is not much of it exported, but its home use is universal.

Acid leather.—Domestic and foreign hides are used, which are first soaked about two weeks, split down the back, and then put in hide mills to soften them; then hung in sweat pits well protected from the weather, where decomposition sets in. The pits are kept damp and warm. In five to seven days the hair starts; they are then taken out and worked in hide mills, which forces nearly all the hair off. Some tanners lime a little after sweating. When hair and flesh are removed, sides are thrown into water, colored, plumped in acid vats forty-eight hours, then washed, oiled, dried, dampened, sammied, and rolled. Most of the sole leather exported is made by this process. The following table shows the number of pounds of sole leather exported for ten years past and its value:

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1879	28,719,623	$5,846,882	1884	22,421,293	$4,613,106
1880	21,834,492	5,086,118	1885	27,313,766	5,416,830
1881	28,690,648	6,472,695	1886	24,265,880	4,825,615
1882	33,777,711	7,059,906	1887	30,530,488	5,695,151
1883	28,593,894	6,038,097	1888	28,713,473	4,959,363

HARNESS LEATHER.

Domestic steer hides, free from brands, scores, or horn scratches, are used for making harness leather. The hides are washed, green fleshed, and limed five days by reeling over from one lime vat to another, the last vat having the strongest lime water; then put in a fresh-water pool, and worked through an unhairing machine to cleanse thoroughly of lime and hair; then hung on frames in vats containing weak liquors for three weeks. After this some split the hides into sides; others wait until the tanning process is completed. After the manipulation of the hides or sides they are handled two weeks with tanning liquors, then laid away in liquor and bark from seventy-five to ninety days; then taken out, washed, shaved on the flesh, scoured by machine, partially dried, and then set out to make a firm grain; stuffed with fish oil and tallow on the flesh side, dried, blackened on the grain with dye made from copperas and liquors, and then finished by having all the grease taken off by slickers and brushes.

Bridle leather is finished same as harness, but is trimmed close.

Russet skirting is bleached after it leaves the scouring machine, and otherwise finished like harness, only using less grease.

Harness leather is sold as "long harness," which is the whole side with belly off, or as "harness backs," in which all the offal is trimmed off. It is exported to Europe to some extent, but mostly in the manufactured state. The exports of saddlery and harness for the last four years have been in value:

1885	$178,411	1887	193,153
1886	190,894	1888	195,522

CALFSKINS.

Green calfskins are washed in a vat, then handled in a solution of lime and water about a week to loosen the hair, then unhaired over the beam; put in a bate of hen manure for about twenty-four hours, after which they are washed out and worked over the beam to clear them, and put in coloring wheels to set the color; then into tan liquors, and handled from one bate to another for sixty days, taken out, shaved, scoured, stuffed with tallow, set out, dried and whitened, and then blacked on the flesh side with a preparation of vinegar, iron filings, and lampblack. Calfskins are not exported, but our tanners are making them of such excellent quality that they have almost entirely put a stop to the imports of French and German skins, which until recently came here to the value of $3,000,000 to $5,000,000 worth annually. Ooze calf is tanned like other skins, but prepared so as as to show very little grain, and the fleshed side is run over an emery wheel. It is finished in colors. Calfskins are also tanned in japonica, shaved, colored, and made into gloves.

UPPER LEATHER.

To make this leather, cow hides of a light average weight are considered preferable. These are washed, fleshed, put in lime five days in vats with rocking wheels, then unhaired and thrown in a bate of hen manure one day, then wheeled in weak liquors two hours to form the grain. After this they are put in liquors and changed every day, giving stronger liquors, from time to time, for about three months; then skived and split, scoured, stuffed, whitened, and blacked on the flesh side. The split which is taken off is stuffed with tallow and finished on either side, according to the purpose for which it is wanted.

COWHIDE FANCY LEATHER.

Green cowhides are tanned and finished into imitation Russia leather for bookbinder's use. These hides are tanned same as for grain leather, but before finishing are split into three parts. The flesh side, after being split, has what is termed

a leveling split taken off. This is very thin and used for cheap trunk covering. The remaining portion is rolled on both sides and finished into "flexible soles." The grain side is colored red and finished in imitation Russia leather.

Raw steer or cow hides, tawed in oil, are made into belting, lace leather, picker and fly-net leather, whips, washers, hamestrings and halters. The process is patented.

FORMULA FOR TANNING AND FINISHING CHICAGO OIL-GRAIN LEATHER FOR BOOTS AND SHOES.

For the best manufacture slaughter hides are necessary. These are soaked in water to remove dirt and salt, carefully fleshed, then limed to remove the hair. After removing the hair they are again soaked in water and put in bate of pigeon manure and water to extract the lime. After this is effected they are again washed and put in mild liquor, where they remain for something less than two months. When they are thoroughly tanned they are taken out and run through a machine to split to the desired thickness. They are stuffed in a revolving wheel with soft grease, hung up to dry, and when sufficiently dry and firm they are stained with a preparation which, in combination with the free tannin in the leather, forms a fixed black; then they are pebbled with a roll having cut in it the desired figures. They are then boarded or softened by rolling between two cork boards. Some preparation is then put on to give the desired finish or gloss to the leather. Then the leather is ready for market.

This leather is run through a machine before it is blacked, and a piece taken off the flesh side, which is known as a split. This is blacked and finished similar to the grain.

The export of buff, grain, and split leather for the past five years has been in value as follows:

1884	$2,062,651	1887	$3,073,833
1885	2,578,991	1888	2,849,208
1886	2,505,456		

PATENT AND ENAMELED LEATHER.

Large, spready green hides are used for this leather. These are soaked, limed, unhaired, fleshed, and bated in the usual manner. On removal from the bate, the hides are worked in a hide mill, through which passes a stream of water. There they are worked over with a bate stone, then placed in a wash wheel, where they are worked for twenty minutes, and then go into handlers, where they are properly prepared for the reception of the tan liquor. The hides are tanned in vats having a circular bottom, where a revolving wheel agitates both liquor and hides. When about one-third tanned a buffing is taken off by hand or machine. Then they are put in the belt-knife splitting machine and divided in three parts. The grain side is enameled in various colors for carriage tops or upholstery purposes. The middle split is used for splatter boards, or carriage and harness trimmings, and the flesh split for shoes. These splits are tanned in a wheel with gambier liquor, scoured by machinery, stretched on frames, and taken out and dried. Then a mixture of about equal parts of white lead, litharge, and linseed oil, boiled to a sirup, is laid on for a ground work. They are tacked on frames and put in driers face down, then taken out and rubbed with pumice stone; then coated with a mixture of linseed oil, ivory black, and a little spirits of turpentine, and dried thoroughly after each application except the last one, when they are rubbed down with fine pumice applied with flannel. The sides are finished with a varnish of linseed oil and turpentine in equal parts, copal varnish half the same, and a little asphaltum or ivory black. This leather is exported to some extent. The exports for the past five years have been:

1884	$116,817	1887	$175,062
1885	291,943	1888	143,598
1886	194,600		

CARRIAGE AND FURNITURE LEATHER.

Hides for this leather are selected specially for being very large and spready; must measure at least 6 feet long by 6 feet wide. Hides are soaked, fleshed, limed, unhaired, and bated in order to free the grain entirely from lime, then laid in sour liquor as a whole hide. After a month's tannage they are taken to the splitting machine and split evenly in two parts. These two parts receive slight further tanning, and are then split again, making four splits altogether, which are known as grain buffing, machine buffed, middle split, junior split. The first or grain split is used for pocketbooks, bookbinding, and linings for hats, being stained for this purpose. The machine buffed is employed in carriage top leather, carriage cushions, and for furniture upholstering. The third or middle split is for dashboards and for patent harness leather. The junior split is sold to manufacturers of cheap shoes.

Continuation of tannage: After splitting the partly tanned hides they are placed in a weak, fresh bark liquor for a short time, then laid in a bath of sumac liquor, which softens them and completes the tanning. They are then dried, then dampened and stuffed with tallow and grease and stretched on a frame, to which they are tacked and left to dry. After drying comes softening, then they are retacked on the frame and painted with from five to twelve coats of a black, shining mixture, called japan. The leather is dried in steam ovens after each coating. Patent leather receives more japan than upholstering leather, which is blacked lightly, then painted with the desired color. The furniture leather when dried is softened on special machines, hence its pliability. Some leather is boarded after the light japanning is dried, and made to assume an artificial grain. Carriage-top leather is treated in this way.

MOROCCO AND KID LEATHER.

These choice fabrics are usually made from foreign raw stock, but Texas and other domestic skins to the extent of about a million skins a year, are tanned. This stock is used in the manufacture of shoes.

The skins are put in a "soak" of water two days, then red arsenic is applied for twenty-four hours, until the hair comes off easily over the beam; then they are put in limes two weeks and handled; then pured with dog manure three to eight hours. This is followed by "salting" on the grain and fleshing with knives on the flesh side, after which the skins are put in a mixture of bran and water to clean them, ready for tanning in alum, gambier, oil, soap, or sumac, according to the kind of leather to be produced. The skins are shaved on the flesh, after tanning blacked and finished on the grain side in glazed, pebble, straight grain, brush grain, or brush kid, which are the usual finishes. There is not much morocco exported, but our manufacturers have improved their product during the past five years, especially in making glazed kid, so that it has almost entirely displaced the imported article, which formerly came into the amount of about $5,000,000 worth yearly.

RUSSIA LEATHER.

This leather is made in Newark, N. J., from cow or steer hides, and used for pocketbooks, furniture leather, traveling bags, etc. The hides are soaked, unhaired, and fleshed, then swelled forty-eight hours in a preparation of rye and oat flour, yeast and salt, then placed in a solution of willow and poplar bark, then handled for three weeks in bark liquors, split into two or three parts. After tanning, the hides are cut into sides, washed, dried, and greased with a mixture of birch and seal oil, after which they are dyed in any color.

SHEEPSKINS.

The wool skins are first washed and then the flesh side is painted with lime, and they are laid away for two or three days, when the wool loosens and is worked off over the beam. The pelts are put in lime vats from five to fourteen days, according to the kind of leather to be made. They are scraped on the flesh, washed, and put in a drench of bran and rye flour, which ferments and by chemical action opens the pores of the skin, takes out the lime, and prepares the pelt for tanning, after which they are "scudded" on the grain side to remove impurities, washed and "processed" by being put in solution of salt, sulphuric acid, and water, where they remain three to ten hours. This preserves the skin for an indefinite period, and is called process tanning, and is most generally used with sheepskins.

Another method is to throw the skins from the beam into either bark liquor two weeks, alum one day, or sumac liquor two weeks, where they are tanned, then taken out, hung up to dry, and laid away "in crust" ready to be sorted for the various finishes. A "skiver" is the grain side; a "flesher" the flesh side of a split sheepskin. These are finished white or in colors, and used in shoe, bookbinders', satchel, and pocketbook work. Sheepskins are not exported, but, on the other hand, the processed skins, which come in duty free, are imported to the amount of 15,000 to 20,000 dozen a week on an average.

LACE LEATHER.

This leather is cut in strings and used for lacing belts which transmit power; also for whiplashes, fly nets, or leather strings. It is usually made from a 30 to 40 pound cowhide, unhaired with lime, put in a pack of salt and alum a month, then set out on a machine, stuffed with tallow and oil, buffed, and finished. The tanned leather is mostly made in New York and New England, where it is used for factory purposes. When dry hides are used in its manufacture they are soaked, softened in a mill, washed in a wash mill for a few minutes to remove wrinkles, then split down the back and divided into sides; they are then whitewashed on the hair side by swabbing over them a solution of lime. They are then piled up about 200 sides high, and remain so ten to twenty days, after which they are unhaired, washed in a revolving wheel, and stuffed with tallow and neat's-foot oil. The proportions of these vary according to temperature. Less oil and more tallow is used in summer than in winter. The sides are rolled, shaved on the flesh side, buffed to remove the grain and prevent the lacing from cracking, rubbed with a mixture of lard oil, tallow, and flour, and finished with a glass slicker.

Raw-hide lace leather is made from light cowhides, which are put in a machine, when oil and tallow is forced into them.

Picker leather is made from green steer hides and tanned and finished the same as lace leather. It is used for picker straps in mills.

Walrus leather is used to make wheels on which emery is put to be used by metal polishers. They are tanned a year in strong oak or japonica liquors, for which they are prepared by an alkali process which removes the oil.

HORSE HIDES.

These have only been tanned during the past twelve years in this country. Newark, New York, is the chief seat of the industry. The hides are washed, limed, handled, and unhaired much like other leather intended for upper-leather stock. The sides, after being unhaired, are put in clean water over night, then green shaved and put in a bate of hen manure four or five days. The bate is worked out, they are handled in liquor six or seven days, then laid away in ground barks. Each lay-away extends over about seven weeks. They are tanned six or eight months, and

are then hung in the air to harden, then dampened and split. The sides are flattened and leveled by the currier. In finishing they are scoured and stuffed, set out, whitened and finished by machines, and blacked with soap blacking or other compounds. Two pieces on the rump of the horsehide are known as the shell. After the hide is through the lime this shell is cut out and tanned separately, as it requires different treatment and makes finer leather than the other portion. It is finished on the flesh side, while the rest of the hide is finished on the grain.

ALLIGATOR LEATHER.

Only the belly and sides of the alligator skin are tanned. The back is scaly and not fit to be turned into leather. The skins are soaked two to four days in clear, cold water. They are then limed from eight to fourteen days, according to size of skins, after which they are bated with hen manure made weak, and in this way they are handled ten to fifteen hours, and then cleansed and thrown into a vat of weak hemlock liquor, which is gradually strengthened to 20° in twenty days time, when they are taken out and hung in the open air. They are softened on the flesh side with a tool made for the purpose, then handled in tan liquor of 10° for six or eight days, taken out, scoured and slickered on both flesh and grain side, and stuffed with tallow and oil, set out, blacked with logwood and copperas on the grain side, glassed, "pasted over the black," glassed again, and finished on the grain side with gum tragacanth. When these skins are intended for satchels and pocketbooks they are not blacked, but finished natural color or by the application of aniline dyes.

Imitation alligator leather is made from split steer hides prepared in the ordinary process by tanning in a drum with gambier or oak tanning liquors, dried and treated with a composition of linseed oil boiled with litharge or sugar of lead, mixed with naphtha, benzine, or camphene, with sufficient lampblack to give it coloring. Four or five layers of this composition are applied, the hide being dried and pumice-stoned between each operation. The last coat is not smoothed off, but the side is then dampened and passed between rollers or dies, when it is embossed with the desired impression to represent an alligator hide. Any desired impression for furniture leather, wall leathers, or hangings can be given by rolls made to produce any figure required.

CHAPTER XVII.

INJURIOUS AND BENEFICIAL INSECTS IN THE UNITED STATES; INSECTICIDES AND INSECTICIDE APPLIANCES.

By C. V. RILEY.

INSECTS INJURIOUS TO AGRICULTURE IN THE UNITED STATES.

The injury to agriculture occasioned by insects is more marked in the United States than in any other country of the world. This excessive depredation may be in part explained by the exceptionally large number of native injurious species. Of about 25,000 described species in the United States, Prof. Lintner (4th Rep't, Ins. N. Y., p. 188) estimates that at least one-half prey upon materials useful to man, and that from 7,000 to 8,000 of these are sufficiently injurious to be justly ranked as pests. He records no less than 210 as affecting the apple, and concludes that we have at least 1,000 fruit insects alone. A list nearly equal in number to that of the apple insects could be made for many other of our principal fruits, or for each of the cereals, grasses, and forest trees. The condensed catalogue of the exhibit (See Appendix IV.) gives a general view of the insects affecting particular trees, fruits, or crops, and especially of those species which from their excessive depredations are of most concern to American agriculture.

In addition to our native species we have to contend with many of the most injurious insects of foreign countries; for many species have been and are constantly being introduced, especially along the chief lines of travel. Prominent among these are the Wheat Midge (*Cecidomyia tritici*), Hessian Fly (*Cecidomyia destructor*), Hop Louse (*Phorodon humuli*), Imported Cabbage Worm (*Pieris rapæ*), and Codling Moth (*Carpocapsa pomonella*), the Fluted Scale (*Icerya purchasi*), in California, and hosts of others, many of which are perhaps not particularly injurious in their native countries, but which, brought to America, without their accustomed bird and insect enemies, or the infectious diseases which attack them in their native home, multiply excessively and become most serious pests.

"But there are other just as potent facts which tend to bring about the greater destructiveness of introduced species, and one that has not been fully realized has always struck me with much force. It is this, that most of such species are introduced from Europe or older civilizations, where, on evolutional grounds, it is natural to suppose that they are the very species which have become accustomed to the civilized conditions. In other words, the species which most abound, and have most successfully accustomed themselves to such artificial conditions, have, in the geologically brief period of man's preëminence, acquired advantages over species which have not been submitted to such environment. The former, when brought

into competition with the latter, under such conditions, rapidly outnumber them and get the upper hand."*

The peculiar methods of American husbandry are also chargeable, to a considerable extent, with the prominence assumed by noxious insects. Our wide extent of territory, and the consequent cheapness of land, have induced slack methods of cultivation not seen in older and more thickly settled countries. This, with the growth of the same plant, year after year, and over large areas, has enabled many insects to multiply to an extent that would have been impossible with careful and clean husbandry following a rational system of rotation of crops.

The losses occasioned by insects injurious to agriculture are, in the aggregate, enormous, and have been variously estimated at from $300,000,000 to $400,000,000 annually. Crops are often reduced one-fourth or one-half, and sometimes are destroyed over large areas.

The damage done to the wheat crop of New York in the year 1854 by the Wheat Midge was estimated by Dr. Fitch to exceed the value of $15,000,000. The cash value of the corn and wheat destroyed by the Chinch Bug (*Blissus leucopterus*) in the State of Illinois in 1867 was over $73,000,000.

The loss occasioned by the Rocky Mountain Locust (*Caloptenus spretus*) to corn, potato, and other crops in 1874 in the States of Kansas, Nebraska, Iowa, and Missouri was estimated at $56,000,000, and considering the effect of the very general failure of these crops upon business men and mechanics, the actual loss to these four States in a single year by this one insect amounted to at least $100,000,000. (First Report United States Entomological Commission, 1877, p. 21.)

The loss to the principal cotton-growing States by the Cotton Worm (*Aletia xylina*, Say), I have shown by careful estimates (Fourth Report United States Entomological Commission, p. 3) to amount, in years of great prevalence of this pest, to about $30,000,000, and the average annual loss, prior to the investigations I made and the mode of prevention now generally adopted, was $15,000,000.

LITERATURE OF ECONOMIC ENTOMOLOGY IN THE UNITED STATES.

In view of these yearly losses from noxious insects, the very creditable work done in applied entomology in the United States, as compared with that of older countries, is not more than should be expected.

While, in the systematic study of insects, the description and proper grouping of species, various European countries have taken the lead and have accomplished the bulk of the work, the United States may justly claim to have excelled in the study of the life histories of injurious insects, and more especially in the discovery of methods of checking or controlling their ravages, as also in fostering beneficial species.

The credit for our superior literature of applied entomology and for the discovery by us of the more important insecticides and appliances now in use the world over, and, in fact, the establishment of practical entomology on a scientific basis is due, in a large measure, to the more liberal aid given to the work, especially of late years, by both our National and State governments than has been afforded by other countries.

METHODS AND DIFFICULTIES OF INVESTIGATION.

In order that the work done in the study of noxious insects in the United States may be more fully appreciated it may be well here to indicate the knowledge of the facts regarding any particular species which is essential to the intelligent control, and of the difficulty frequently experienced in obtaining such knowledge. In doing so I quote more or less directly from my previous writings on the subject.

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* From a paper by the author read before the Philosophical Society of Washington, March 31, 1888, upon "Some Recent Entomological Matters of International Concern."

In the first place the full life-history and habits of the species to be dealt with must be known, and this implies a great deal of close and accurate work in field and laboratory, frequently necessitating the joint efforts of a large number of observers continued through a series of years. The relations of the species to wild plants, as well as to the particular cultivated crops which it affects must be studied, as also its relations to other animals. "Indeed, its whole environment must be considered, especially in connection with the farmer's wants, the natural checks which surround it, and the methods of culture that most affect it. The habits of birds, the nature and development of minute parasitic organisms, such as fungi, the bearing of meteorology must all be considered, and yet with the knowledge that a study of all that these things implies, one will frequently fail of practical results without experiment and mechanical ingenuity. * * * Mere study of this kind, however essential, is not often productive of those important practical results which follow when it is combined with field-work and experiment by competent persons and upon scientific principles. * * * It took me five years, with a number of observers at command, to definitely settle some points in the life history of the Cotton Worm, and with all the resources of the French Government,its liberal premiums, its superior and subcommissions appointed for the purpose and at work for the past fifteen years, there is much that is yet mooted in reference to the Grape Phylloxera."*

Studies of such widespread and national species as the Rocky Mountain Locust, Chinch Bug, Hessian Fly, Army Worm (*Leucania unipuncta*), Codling Moth, Imported Cabbage Worm, Cotton Worm, Plum Curculio (*Conotrachelus nenuphar*), and a host of other insects have been carried on continuously through a great number of years; yet previously unknown facts or new methods of preventing their depredations are discovered almost every year.

The recent successful use of arsenical poisons against the Codling Moth, and in a less satisfactory degree against the Plum Curculio, the use of kerosene, resin and soap emulsions more particularly against plant-lice (*Aphididæ*) and scale insects, (*Coccidæ*), the study of contagious diseases of the Cabbage Worm and Chinch Bug with relation to their use in controlling these pests, may also be mentioned to illustrate the advance that is constantly being made in our knowledge of methods of preventing the attacks of species long known and well studied.

My recent studies of the Hop Plant-louse, a species which concerns both the American and European hop grower, will serve to illustrate the complicated problems with which the economic entomologist has to deal. For a summary of the facts the reader is referred to the Report of the United States Entomologist for 1888, from which the following concluding passages are taken: "The exact knowledge thus gained simplifies the protection of the hop plant from Phorodon attack. Preventive measures should consist in destroying the insect on plum in early spring where the cultivation of this fruit is desired, and the extermination of the wild trees in the woods wherever the hop interest is paramount; also in avoiding the introduction of the pest into new hop countries in the egg state upon plum cuttings or scions. Direct treatment is simplified by the fact that the careful grower is independent of slovenly neighbors, infection from one hop-yard to another not taking place.

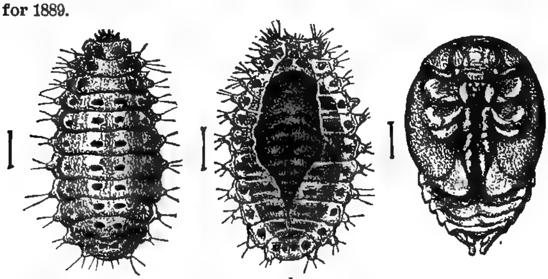
"The bearing of these facts will probably best be brought home by the statement that hitherto hop growers have been groping in the dark and working to prevent injury by applications to the soil. In fact the English hop growers have been led by their very best authorities to waste their energies in this direction. The importance of the matter will appear when I state that the hop crop, which is quite an important one in some parts of this country, and especially important in some parts of Europe, annually suffers from the ravages of this, its worst insect enemy, and in some years is rendered a total failure by it. Further, that some parts of this

* General Truths in Applied Entomology, 1884.

country, as the Pacific coast, are yet free from it, and that hop growers there, by being forewarned may prevent its introduction from the East or from Europe, as there is very little doubt in my mind that the insect has been introduced from one country to another in the egg state upon plum scions, as it may be easily transported from place to place in this manner."

The Fluted Scale, one of the largest of our scale-insects, has of late years done immense injury to the orange groves and to many other trees and shrubs of southern California, and occurs also in Australia, New Zealand, and South Africa. The investigation of this insect has presented many problems difficult of solution, and requiring study on three continents. It has also proved to be one of the most difficult species to control and the experiments with remedies have been most extensive and successful and are given at length in some of my later reports. By the thorough use of various forms of kerosene emulsion young trees may be kept free from this scale at a reasonable expense. Good results have also been obtained by fumigating with hydrocyanic acid gas. Another interesting feature in this work with *Icerya* deserves more particular notice because it illustrates a comparatively untried field for entomological experiments, viz: The study and importation of the foreign parasites of introduced insects. The fact that this species is not so injurious in its native country, Australia, suggested the probable presence there of effective insect enemies. This supposition was sustained by the discovery, in 1886, by Mr. Crawford, of Adelaide, of an important parasite. The now well-known *Lestophonus iceryæ*, Will., a small two-winged fly, the larvæ of which infest *Iceryæ*, one to twelve or more living in the body of a single scale. At my request, Mr. Crawford sent infested *Iceryæ* to California, where my agents succeeded in breeding a number of the flies and attempted to acclimate them there. These limited experiments did not prove satisfactory; and I finally succeeded in sending an agent, Mr. A. Koebele, to Australia to study and collect for importation into California the parasites above mentioned and other natural enemies of this scale. The results of this mission are, up to the present time, most encouraging, and over 12,000 living parasites have been successfully transported to Los Angeles, California, and are confined to infested orange trees under the observation of Mr. Coquillett. I feel quite confident that this interesting parasite will now become firmly established in California and prove as serviceable there in the future as it now is in Australia, and that, with the other natural enemies of the *Icerya*, thus artificially introduced, it will in the course of a very few years so keep in check the destructive scale-insects that the orange growers will save the immense outlay in money and time now required to protect their crops.*

*As is now generally known, the outcome of this work has more than realized my best hopes. This result has been reached not so much through the importation of the *Lestophonus*, which has been satisfactorily accomplished and will result in great good, but by the introduction of the now well-known Lady-bird enemy of the Icerya (*Vedalia cardinalis*). (See Figs. 212 and 213.) The rapid increase and easy spread of this insect, together with its marvelously effective work in destroying the Icerya have been fully described in my later writings, particularly in *Insect Life*, and in my Annual Report for 1889.



a b c

FIG. 212.—*Vedalia cardinalis:* *a*, Full-grown larva; *b*, pupa, dorsal view, inclosed in last larval skin; *c*, pupa, naked, ventral view—all enlarged.

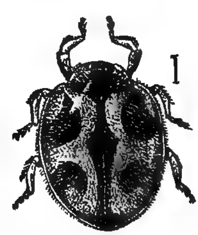


FIG. 213.—*Vedalia cardinalis:* Adult; enlarged.

INSECTICIDES: LATER METHODS ESPECIALLY DESCRIBED.

The discovery by workers in the United States of the more important insecticides, together with apparatus for successfully applying the same, has already been mentioned. The study of and experiments with insecticides have, from the time of Harris to the present day, been a leading feature of the economic work in entomology, and this study and experimentation by State entomologists and by private observers, including practical farmers and fruit-growers, as well as students of insects, have resulted in the accumulation of a long list of substances of more or less value as insecticides, and of extensive knowledge of direct remedies and preventives other than the use of poisons. The list of insecticides given later in the catalogue of the exhibit (Appendix IV) comprises the more important that are now in general use, and under each will be found the formula for its preparation and the method of applying it. I can particularize here only a few, which are the later outgrowth of my work as United States Entomologist, and which have proved of more than ordinary value in the control of certain pests.

The efficiency of the petroleum compounds as insect destroyers has long been known; but their use in full strength and the difficulty of diluting them in water have either occasioned considerable injury to the plants treated, or have detracted from their value, or rendered their satisfactory use impossible. The safe and general use of these substances for the purpose named dates from the discovery in 1880, in my work on the Cotton Worm, that kerosene could be emulsified with either soap or milk, and then be capable of dilution to any extent with water. After considerable experimentation, it was found that the kerosene and milk emulsion could best be secured by churning with a force-pump two parts of kerosene and one part of sour milk, at blood temperature, for ten to fifteen minutes, or until the liquid assumes a thick creamy or buttery consistency.

The emulsion with soap is obtained by dissolving one-half pound of soap in one gallon of water heated to the boiling point and then adding the resulting mixture, boiling hot, to two gallons of kerosene. Churning, as in the former instance, will result in a like buttery compound. Where water is "hard" or contains considerable lime it should be softened with soda, and it were better to use rain water in all cases. These emulsions are quite stable and may be kept indefinitely. They may be diluted for use with from ten parts of water upward, according to practical need, and sprayed in the ordinary manner. They are of especial service against Aphids and Coccids and against all sucking insects, where the arsenical poisons are not available. Recent experiments at Washington (see *Insect Life*, August, 1888) have shown that they may also be used successfully to destroy Scarabaeid larvæ infesting lawns, etc. The experiments in question were directed against the larvæ of *Allorhina nitida*, which were seriously infesting the Capitol grounds. The emulsion was applied liberally to the soil, which was for some days thereafter kept freely soaked with water. The treatment resulted in immediately stopping the work of the grubs, and later in their total destruction. In adjoining grounds, not treated the grubs continued their depredations. This fact is important to European cultivators, who suffer so much from the depredations of the larvæ of the Cockchafer. The kerosene emulsions are also among the best remedies for Phylloxera and other underground insects, and are equally valuable as washes to disinfect our domestic animals of parasites.

A third kerosene emulsion, which has been used with success against scale-insects in California in 1887 and 1888, is best obtained by taking one part of kerosene and one part of a resin compound (a soap to be noted later), to which is added a small amount of arsenious acid, the whole being churned as in the previous instances. This emulsion was first used without the arsenic, but the addition of the latter was found to very materially increase its efficiency. (See my Reports for 1887 and 1888.) In the case of Aphids it was found that all of the lice could be killed, while

the beneficial Coccinnellid larvæ preying on them were uninjured and that parasites contained in the lice were not destroyed. The resin compound may best be made by dissolving one pound of caustic soda by boiling in about a gallon of water. To one-half of this solution eight pounds of resin are added and the mixture then boiled until the resin is dissolved, after which the remainder of the soda solution is added and the whole boiled over a hot fire. The resulting compound will assimilate with cold water like milk and may be diluted to make 32 gallons.

Before leaving this subject it may be well to note the value of the addition of sulphur to the kerosene emulsions when these are employed against mites (*Phytoptus* spp.), and the Red Spider (*Tetranychus telarius*), as shown by the experiments of Mr. Hubbard in Florida.

The gas treatment for scale-insects in the open air, as perfected by one of my agents, Mr. Coquillett in California, represents a comparatively new method of fighting insects; and, from the success that has attended the work so far, I am warranted in giving a more particular account of it here. A large number of gases and fumes had been made the subject of experiment by interested parties in California. Among these may be mentioned hot air, steam, tobacco smoke, carbonic-acid gas, chloroform, bisulphide of carbon, sulphuretted hydrogen, and arseniuretted hydrogen. The last-named gas may prove of value, but its claim is not fully established. As all these gases proved much inferior to the hydrocyanic-acid gas, first used by Mr. Coquillett in September, 1886, it is not necessary to give them further mention here.

The following account of the method of using the hydrocyanic-acid gas is drawn from the "Report on the Gas Treatment for Scale-Insects," by Mr. Coquillett, published in my Annual Report to the Commissioner of Agriculture for 1887:

"This gas, when generated in the usual manner, by the action of sulphuric acid upon potassium cyanide dissolved in water, proved to be very destructive to the foliage and fruit of the tree. It was discovered, however, that *dry* gas had no injurious effect on the tree and yet was equally effective against the scale-insects. Among the several processes which were then devised to dry the gas, the simplest and best consists in simply passing the gas as it comes from the generator through sulphuric acid, by which means all the water is abstracted and the gas rendered innoxious so far as the tree is concerned.

"Several excellent tents for confining the gas have been invented. They are made of heavy cloth thoroughly oiled, and are rigged with suitable apparatus for operating them. Two leading styles are in common use. In one the tent is lowered over the tree from above, and in the other the tree is inclosed from one side, the tent being made in the form of two half-tents, which encompass the tree and meet on the opposite side. (Illustrations of these two styles are given at Plates XXVIII and XXIX.

"Provision is made for drawing off the air from the top of the tent as the gas is forced in and to thoroughly agitate and circulate the air within the tent."*

INSECTICIDE MACHINERY AND APPLIANCES.

The discovery of valuable insecticides has been accompanied with like advances in devising mechanical contrivances and appliances for their proper application.

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*Later experiments by Mr. Coquillett under my direction, have resulted in the discovery of a simpler and at the same time more effective method of using this gas. It is described in *Insect Life*, vol. II, pp. 202-203, as follows: It consists in using one part by weight of dry or undissolved potassium cyanide, with one part sulphuric acid and two parts of water. The generator is made of lead and is somewhat in the form of a common water-pail. After the tent is placed over the tree the necessary quantity of the dry cyanide is placed in the generator, the proper quantity of cold water added, and the generator placed under the tent near the trunk of the tree; the acid is then added to the materials in the generator, a barley sack thrown over the top of the latter, after which the operator withdraws, and a quantity of earth is thrown upon the lower edge of the tent where it rests upon the

THE CULVER FUMIGATOR.

THE WOLFSKILL FUMIGATOR.

The distribution of dry poisons, such as the arsenical mixtures, pyrethrum powder, hellebore, lime, ashes, etc., does not present any particular difficulty, and may be easily and satisfactorily accomplished by the use of one or other of the various rotary, oscillating, or gravitational distributors of poisons mentioned in the catalogue of the exhibit. (See Appendix IV.)

As, however, most of the better insecticides are now ordinarily used in the form of liquid, the invention of machinery has largely been directed to the construction of pumps and nozzles wherewith to properly atomize and distribute such poisons.

The pumps used for this purpose are sufficiently varied in size and style to meet all requirements for both limited and extensive work. The representative pumps in general use in this country are indicated in the catalogue of that part of the exhibit.

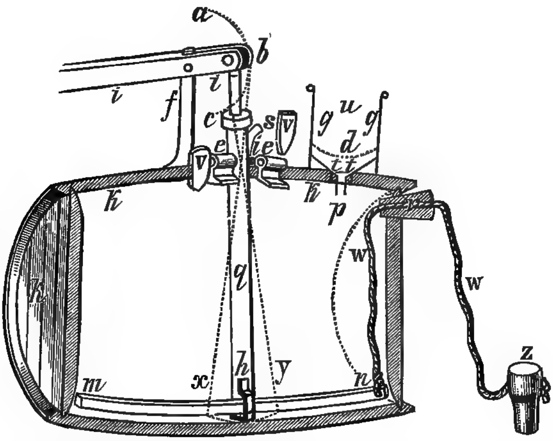

FIG. 214.—*Stirrer pump with barrel and mixer funnel in section*; *u* funnel; *g g* its cylindrical sides, funnel base, *t t*; spout, *p*; (in bunghole *k*) gauze septum, *d*; barrel, *k k*; trunnions, *i*; trunnion eyes, *e*; wedge *v*; lever fulcrum, *f*; pump-lever, *i i*; swing of the lever head and piston top, *a b c*; cylinder packing cap, *c*; cylinder, *q*; its swing, *x y*; stirrer loop or eye, *h*; stirrer bar, *m n*; rope, *w w*; bung, *r z*.

To do good work a pump must have sufficient power to overcome the resistance of the nozzle and throw the liquid far enough to accomplish the purpose aimed at. Another, and very essential feature of the larger pumps is some suitable contrivance for constantly agitating the liquid to keep the ingredients well mixed. A very serv-

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ground to prevent the escape of the gas. After the expiration of fifteen minutes the tent is removed and placed upon another tree.

The following table, based upon several of the tests referred to above, will aid in determining the proper quantity of each ingredient to use in treating orange and lemon trees:

Height of tree.	Diameter of tree.	Cyanide of potash.	Water.	Sulphuric acid.
Feet.	*Feet.*	*Ounces.*	*Fluid ozs.*	*Fluid ozs.*
10	8	2¼	4½	2¼
12	10	4½	[illegible]	4½
12	14	8¾	17½	8¾
14	10	5½	11	5½
14	12	7½	15	7½
16	14	12	24	12
18	14	15	30	15

iceable pump, developed, with the assistance of the late Dr. W. S. Barnard, in my work for the Government and which fulfils all these conditions is the stirrer pump. It consists of an ordinary double-acting force pump inserted into the bunghole of a barrel, and supported at its point of contact upon trunnions. The action of the handle causes the pump to oscillate on its trunnions and by this means a stirrer bar attached to the lower end of the pump is made to sweep back and forth in the lower side of the barrel, thus keeping the poison thoroughly agitated and mixed. A model of this pump, fitted with suspension pipes, Y-forks and Riley nozzles for underspraying eight rows at once, is shown in exhibit No. 99, and illustrates a form used by me in the experiments upon the Cotton Worm.

SPRAY NOZZLES.

The most important part of a machine for the distribution of a liquid poison is the nozzle, for upon it depends, in large measure, the success or failure of the experiments. I have elsewhere stated the desiderata of a good spray nozzle as follows: "Ready regulation of the spray to be thrown; greatest atomizing power, with least tendency to clog; facility of cleansing or ready separation of its component parts; cheapness; simplicity, and adjustibility to any angle."

Among the many used in the United States, and which are largely represented in the exhibit of nozzles, two may be noticed here, which, in superior degree, fulfill the requirements, viz: The Riley and the Nixon nozzles. The first and more important of these is the Riley or Cyclone nozzle. The rotation of the liquid secured by this nozzle represents an entirely new principle in the distribution of liquid insecticides; and a principle that may be used with advantage in many of the different forms of nozzle; such as the slit, deflector, many-punctured, as well as solid jet.

The form which I have adopted as the standard (Fig. 152, *ante.*) may be briefly described as follows: "It consists of a small chamber with two flat sides, one of these screwed on so as to be readily removed. Its principal feature consists in the inlet through which the liquid is forced, being bored tangentially through its wall so as to cause a rapid whirling or centrifugal motion of the liquid which issues in a funnel-shaped spray through a central outlet in the adjustable cap. The breadth or height, fineness or coarseness of the spray depends upon certain details in the proportions of the parts, and especially of the central outlet." The Riley nozzle is now made with direct, oblique or side face outlets to meet the general requirements of surface and underspraying of foliage. The principle of this nozzle first occurred to me in 1879 and was first put into practice in the course of my work on the Cotton Worm in 1880. After innumerable trials, covering a period of two years, by myself and assistants and particularly Dr. Barnard, the Riley nozzle, as described above, was evolved. A large number of these provisional forms, illustrating the development and perfection of this nozzle, and also its various modifications are shown in the exhibit.

The value of this nozzle has been universally recognized and it (or modifications of it) is now in common use in widely separated parts of the world. This is particularly the case in France, where (since I introduced it in an address at Montpellier, in 1884) it has come rapidly into use in combating both insects and fungi, and various important modifications, like the Vermorel (Fig. 62), the Japy (Fig. 63, *ante.*), and the Marseilles, have been perfected. A number of the principal foreign modifications of the Riley nozzle are included in the exhibit.

One important modification worthy of mention has been developed since in America, viz: The universal spray tip of John Crofton and L. D. Greene, of Walnut Grove, Cal. This nozzle is so contrived that by the turning of a plug similar to a stopcock, any one of a number of outlets may be used, giving direct or side spray at the will of the operator.

The Nixon or Climax nozzle, manufactured by A. H. Nixon, of Dayton, Ohio, deserves mention here as one of the recent additions to our spray nozzles and one of considerable value, especially where direct spray is desired of greater force and volume than can be ordinarily given by the Riley nozzle.

The spray is produced in the Nixon nozzle by projecting the water against a wire screen. The quantity of the spray is regulated by the size of the opening admitting the water to the screen, and its fineness by the use of screens varying in fineness of mesh.

PRESENT STATUS OF ECONOMIC ENTOMOLOGY IN THE UNITED STATES.

This article may fitly be closed with a brief reference to the present status of the work in applied entomology in the United States, including the names of those now especially engaged in its prosecution.

The working force may, for convenience, be divided into two groups: First, those engaged in United States Government work, and represented by the Division of Entomology of the United States Department of Agriculture, and the curator and assistant curator of insects of the National Museum. Secondly, the entomologists of the State experiment stations, including the State entomologists of New York and Illinois.

The scope of the work of the Entomological Division of the United States Department of Agriculture is indicated in part by what has preceded, and while it includes the whole field of agricultural entomology, the work is especially directed to the study of insects of national importance, or such as demand, from the difficulty or extent of the work, a greater outlay of money than can be afforded by the States. Illustrations of questions of this nature have already been given in the references to the Cotton Worm, Rocky Mountain Locust, Chinch Bug, Hop Louse, Buffalo Gnat (*Simulium* spp.), etc.

The results of these labors are given to the public in the various publications and reports of the Division, including the Annual Report to the Secretary of Agriculture; in bulletins issued from time to time, of which nineteen have been published, giving full histories and remedies for particular insects, or insects affecting special crops, etc., and in the monthly bulletin, "*Insect Life*," now completing its first year. These publications are, as a rule, widely distributed over the United States. The bulletins prepared for special interests are, however, extensively distributed only in the sections where the particular pest is found or crop grown.

That there is a widespread interest in this work is shown by the fact that some of the bulletins of the Division have passed through several editions, and that "*Insect Life*" has already a mailing list of about 1,600 names.

The work of the Curator of Insects of the National Museum is either of a purely scientific or of a strictly museum character. The former includes the work of the curator and specialists employed from time to time in monographing particular groups of insects; the latter, the ordinary routine work of the arrangement and care of specimens, and the naming of material sent in for identification. A very important feature of the work is the preparation of an economic display that shall illustrate as far as possible the life-histories of our principal injurious insects, and the nature of their depredations. A part of it is included in the exhibit, and the catalogue of it, which has been prepared for publication, will indicate its character and extent. (See Appendix IV.)

The record of the work of the curator and assistants appears in the publications of the Smithsonian Institution and of the National Museum.

The following list embraces those engaged in Government entomological work, and includes both permanent and temporary employés:

DIVISION OF ENTOMOLOGY, UNITED STATES DEPARTMENT OF AGRICULTURE.

Entomologist: C. V. Riley.

Office staff: L. O. Howard, first assistant; E. A. Schwarz, Th. Pergande, Tyler Townsend, C. L. Marlatt, assistants; Philip Walker, assistant in silk-culture and in charge of reeling experiments.

Field agents: Samuel Henshaw, Boston, Massachusetts; F. M. Webster, Lafayette, Indiana; Herbert Osborn, Ames, Iowa; N. W. McLain, Hinsdale, Illinois; Mary E. Murtfeldt, Kirkwood, Missouri; Lawrence Bruner, Lincoln, Nebraska; D. W. Coquillett, Los Angeles, California; Albert Koebele, Alameda, California.

DEPARTMENT OF INSECTS, UNITED STATES NATIONAL MUSEUM.

Honorary Curator: C. V. Riley.

Aid: Martin L. Linell.

The State experiment stations, recently established under the provisions of the "Hatch Bill," have, in a large number of instances, recognized the importance of entomological study by appointing station entomologists. This has resulted in a very large addition to the working force in applied entomology in the United States, and we may expect a corresponding increase in the future of our knowledge of insects in their relations to agriculture. The work of these offices will bear directly on local insects, or the relation of more widely spread forms to particular States, and will thus materially supplement the labors of the United States Entomologist.

The State Entomologist of Illinois takes the place of the experiment station entomologist in that State; and in New York, a State Entomologist is provided for in addition to the Experiment Station Entomologist.

The publications of these State and station officers, in the form of bulletins and annual reports, will have an especial local interest and circulation.

A list of the State and Station Entomologists so far provided for is here given:

Alwood, W. B., Blacksburg, Virginia.
Atkinson, G. F., Columbia, South Carolina.
Beckwith, M. H., Newark, Delaware.
Bruner, L., Lincoln, Nebraska.
Clark, J. W., Columbia, Missouri.
Comstock, J. H., Ithaca, New York.
Cook, A. J., Agricultural College, Michigan.
Fernald, C. H., Amherst, Massachusetts.
Forbes, S. A., Champaign, Illinois, (State Entomologist).
Francis, M., College Station, Texas.
Gillette, C. P., Ames, Iowa.
Harvey, F. L., Orono, Maine.
Lintner, J. A., Albany, New York (State Entomologist).
Lugger, O., St. Anthony Park, Minnesota.
Morse, F. W., Berkeley, California.
Neal, J. C., Lake City, Florida.
Orcutt, P. H., Brookings, S. Dakota.
Perkins, G. H., Burlington, Vermont.
Popenoe, E. A., Manhattan, Kansas.
Smith, J. B., New Brunswick, New Jersey.
Summers, H. E., Knoxville, Tennessee.
Tracy, S. M., Agricultural College, Mississippi.
Webster, F. M., Lafayette, Indiana.
Weed, C. M., Columbus, Ohio.
Woodworth, C. W., Fayetteville, Arkansas.

SILK-CULTURE IN THE UNITED STATES.

Having repeatedly discussed the general subject of silk-culture in the United States during the past twenty years I shall do little more in this connection than cull from my previous writings on the subject, and more particularly from the preface to the second edition of my "Manual of Instruction in Silk Culture" (Washington, 1882), and from my Report to the U. S. Commissioner of Agriculture, for 1888, now in press.

Disappointment is sure to follow exaggerated and visionary notions upon the subject, and it may be well to emphasize the facts that the elements of successful silk culture on a large scale are yet wanting in the United States; that the profits of silk culture are always so small that extensive operations by organized bodies must prove unprofitable where capital finds so many more lucrative fields for employment; that extensive silk raising is fraught with dangers that do not beset less ambitious operations; that silk-culture, in short, is to be recommended only as a light and interesting employment for those members of the farmer's household who either cannot do or are not engaged in otherwise remunerative work.

The want of experience is a serious obstacle to silk-culture in America, for while the mere feeding of a certain number of worms and the preparation of the cocoons for market are simple operations, requiring neither physical strength nor special mental qualities, yet skill and experience count for much, and the best results cannot be obtained without them. In Europe and Asia this experience is traditional and inherited, varying in different sections both as to methods and races of worm employed. With the great variety of soil, climate, and conditions prevailing in the United States, experience in the same lines will also vary.

The greater value of labor with us as compared with labor in the older silk-growing countries has been in the past a most serious obstacle to silk-culture in the United States, but conditions exist today which render this obstacle by no means insuperable. In the first place, comparative prices, as so often quoted, are misleading. The girl who makes only twenty or thirty cents a day in France or Italy does as well, because of the relatively lower prices of all other commodities there, as she who earns three or fourfold as much in America. Again, the conditions of life are such in those countries that every woman among the agricultural classes not absolutely necessary in the household, finds a profitable avenue for her labor in field or factory, so that the time given to silk-raising must be deducted from other profitable work in which she may be employed. With us, on the contrary, there are thousands, aye, hundreds of thousands, of women who, from our very conditions of life, are unable to labor in field or factory, and have, in short, no means, outside of household duties, of converting labor into capital. The time that such might give to silk-culture would, therefore, be pure gain, and in this sense the cheap-labor argument loses nearly all its force. This holds more particularly true in the larger portion of the South and West that are least adapted to the production of merchantable dairy products, or where bee-keeping and poultry-raising are usually confined to the immediate wants of the household.

The want of a ready market for the cocoons is now, as it always has been, the most serious obstacle to be overcome, and the one to which all interested in establishing silk-culture should first direct their attention. Ignore this, and efforts to establish the industry are bound to fail, as they have failed in the past. A permanent market once established, and the other obstacles indicated will slowly but surely vanish as snow before the coming spring. Owing to the prevalence of disease in Europe there grew up at one time a considerable demand for silkworm eggs, so that several persons found the production of these eggs quite profitable. Large quantities were shipped across the continent from Japan each winter, but this demand was in its nature transient and limited, and, with the improved Pasteur method of selection and prevention of disease, silk-raisers are again producing their own eggs in Europe. Silk-culture must depend for its growth, therefore, on the production of cocoons, and these will find no remunerative sale except where the silk can be reeled.

Under a heavy protective tariff our silk manufactures have rapidly grown in importance and wealth, and annually consume some $20,000,000 of "raw silk." Now, the so-called "raw silk" thus imported is just as much a manufactured article as the woven goods, and its importation free of duty is as much an encouragement to

foreign manufacturers and an impediment to home industry as the removal of the duty would be on woven goods.

The obstacles which silk-culture meets in the States are none of them permanent or insuperable, while we have some advantages not possessed by other countries. One of infinite importance is the inexhaustible supply of Osage Orange (*Maclura aurantiaca*), which our thousands of miles of hedges furnish; another is the greater average intelligence and ingenuity of our people, who will not be content to tread merely in the ways of the Old World, but will be quick to improve on its methods. Still another may be found in the more spacious and commodious nature of the barns and outhouses of our average farmers. Every year's experience with the *Maclura* confirms all I have said of its value as silkworm food.

The people of the United States have always felt more or less interest in this subject of silk-culture, and the establishment of this industry has been the object of innumerable efforts since the settlement of the country.

During the reign of James I of England, or in the beginning of the 17th century, sericiculture was first attempted in Virginia. Other efforts were subsequently made, but were very naturally abandoned for the obvious reason that the raising of tobacco, cotton, and sugar were found more profitable.

Many years subsequently it began to attract renewed attention, and was gaining strength and importance when the Revolution deranged and crushed it. After the Declaration of Independence feeble efforts were made to naturalize the worm in the more northern States; and, according to William H. Vernon, of Rhode Island, $30,000 or $40,000 were annually realized from the rearing of the worms in Connecticut, at the beginning of the present century. This industry soon died out, however, and, indeed, the climate of the New England States is not the most suitable for profitable silk-raising.

The financial depression of the second decade of the present century called forth a resolution from Congress instructing the Secretary of the Treasury to submit a report upon silk-culture and the advisability of pushing its establishment in America. Such a report was submitted in 1828 by Secretary Rush and published. It led, however, to no legislation, although there was a duty imposed upon raw silk prior to 1847, amounting at times to 20 per cent., but in general to but 12½ per cent. Soon followed the *Morus multicaulis* flurry of 1838 and 1839 which turned the heads of rational men and wrecked a substantial attempt to place silk-culture upon a sound basis. As many as 400,000 pounds of cocoons (fresh weight, probably) were produced in some years, but the culture again disappeared in the latter part of the fourth decade. It left no permanent results beyond the mulberry trees scattered over many parts of the country, and these have been of some service of late years. But from these efforts at silk-rearing, aided by wise and abundant tariff assistance, sprung the present silk industry in the United States, which, as already stated, consumes about $20,000,000 worth of raw silk annually, for which we are dependent upon Asia and Europe.

Beside the foolish *multicaulis* mania there existed another grave cause for the failure of silk-raising in the forties, and that was the dearth of skilled labor and the absolute non-existence of such improved machinery as would make that labor less necessary. While the last generation was struggling with their crude home-made reels, the more experienced reelers of Europe were consolidating their machines into large factories called *filatures*. In all our manufactures it was soon seen that besides the encouragement of a protective tariff we must have, too, machinery to the highest degree saving of skilled labor. In the reeling of silk, that process which converts the unmarketable cocoon into the merchantable hank of raw silk no serious improvement in the machinery has ever been put into general use in America, and prior to 1876 no attempt worthy of record was made to make silk-reeling machinery automatic.

From the Centennial Exposition date two efforts—that of certain philanthropic ladies in Philadelphia, California, and elsewhere to again establish silk-culture, and that of Mr. Serrell, of New York, to devise an automatic reel. By the former the attention of Congress was brought to the matter again, and in 1884 an appropriation was made for the encouragement of the industry, and to enable the Department of Agriculture to experiment. This appropriation has been repeated each year since, including the present.

I cannot better state the results of these experiments than by quoting the following from the introduction of my forthcoming Annual Report:

"For the past five years the Department has been carrying on under my direction a series of experiments with a view of testing the feasibility of profitable silk-reeling, and of thus establishing a home market for cocoons. For two years these experiments were made at three different points, viz: San Francisco, New Orleans, and Philadelphia, with a view of establishing filatures at such points.* The result was not satisfactory. There seemed to be, however, from the results which the Serrell automatic reeling machine then gave, some prospect of overcoming many of the difficulties which had been encountered in the earlier attempts, and three years ago Congress authorized the Commissioner of Agriculture to establish a silk filature in connection with the Department at Washington, where it could be directly superintended by myself and Mr. Walker, and to thoroughly test the Serrell automatic machinery. I felt that two years experimentation would enable me to give a definite answer to the question as to whether with this machinery the question of labor could be sufficiently minimized to make silk-reeling profitable in the United States.

"Owing to various vicissitudes and contingencies which it is not necessary to refer to in detail, and particularly from the fact that experimental work under Departmental restrictions is more expensive than it would be in private hands, the results of these two years' experimentation were not entirely satisfactory, though they indicated very clearly that silk could not be reeled at a profit. Some improvements were at that time being perfected in France in the details of the Serrell automatic machinery, which seemed again, according to Mr. Walker, who personally investigated them, to promise well, and to justify the continuation of the experiments; and Congress appropriated for the third time for this purpose and also to provide for the establishment of some choking stations, where the cocoons might be intelligently handled and choked under supervision.

"Owing to the lateness of the season when the appropriation became available, to the fact that the Division was required to make an exhibit at the Cincinnati Exhibition, and, lastly, to the fact that we have found difficulty with the later improvements in the machinery received from France, the work of the present year has not progressed to such an extent as to justify a final conclusion. Some patentable improvements have been made which may overcome some of the chief difficulties hitherto encountered; but I am free to confess that I have little hope of final favorable result so far as the main object of the experimentation is concerned. In short, I do not believe that, with whatever discoveries or improvements we may make, it will ever be profitable to reel silk in this country without some protection against the cheaper labor of foreign countries, and this means that the experiments so far made confirm the arguments which I have always urged as to the necessity of such protection for the establishment of silk culture in America.

"There is no question as to our ability to produce the cocoons, and, as I have urged, we have many advantages over the Old World in this respect; but the five years' experimentation with Congressional aid have simply served to give an artificial impetus to silk-raising, which would again fall back to its former condition upon the withdrawal of such aid.

* The California and Philadelphia silk associations and Mr. Joseph Newman are all receiving Congressional aid at present.

"No one could be more enthusiastic or more interested in his efforts to successfully solve the problem than Mr. Philip Walker, who has direct charge of the filature at Washington; and, after careful calculation, he has estimated that a specific duty of $1 per pound upon the reeled or so-called raw silk would render the reeling profitable in this country. Without such duty, I fear that the continued experimentation with the Serrell reel will be of very little avail. For it must not be forgotten that whatever improvements accrue from our experimentation here will be just as valuable abroad, unless they are protected by patent for the benefit of the American Government.

"Without considering in any way the question of protection in the abstract, it has always seemed to me plain that, if the policy of the Government is protection, there should be no exception or discrimination made in this particular case."

The exhibit is prepared to show some of the results and methods of work, and is as follows: (1) Sixty-four samples of cocoons produced in the United States, both from Italian and French races, and from American reproduction. (2) Raw silk reeled in the experimental filature at Washington, artistically arranged so as to show the arms of the United States. (3) Map of the United States, showing the portions of the country where the samples of cocoons exhibited were raised. (4) Objects used by the Department in instructing silk-raisers. (5) My manual, distributed gratuitously to silk-raisers. (6) Short instructions distributed to silk-raisers. (7) The box used for storing silkworm eggs. (8) The box used for transporting silk worm eggs by post. (9) Sample box of cocoons furnished with eggs. (10) Card, sent with eggs, showing the conditions of hibernation.

APICULTURE IN THE UNITED STATES.

As its economic importance is more generally recognized a widespread and growing interest is manifested in this branch of rural husbandry in the United States. An idea of the present importance of this industry may be gained from the following figures taken from the report of the statistician of the Northwestern Society of Bee-keepers for 1884:

"According to conservative estimates we now have a total of 3,000,000 colonies of bees, which annually yield 120,000,000 pounds of honey. The value of the annual product, at an average of 15 cents a pound, would be $18,000,000." The estimated annual product ranges from $15,000,000 to $20,000,000 and the annual production of wax is about $1,000,000 in value. An added value and increased demand for wax will be given by the demands made by the phonograph and the graphophone, which are destined to come into very general use, and which depend upon a basis of wax for their recording cylinders. This production of wax might be materially increased since not more than 8 or 10 per cent of the persons who are favorably situated for the cultivation of bees are actually engaged therein. Were this proportion increased only to 50 per cent the annual product of honey and wax together would not fall short of $75,000,000 to $80,000,000 in value.

The degree of skill necessary to successfully engage in the cultivation of bees and the production of honey is not greater than that required in keeping a dairy and producing good dairy products. The difference is in kind, rather than in degree, of skill, and one is as easily acquired as the other. The improvements which have been made by scientific and practical apiarists in the United States during the past forty years have resulted in establishing the claims of this industry to an important place among those branches of rural husbandry which are the acknowledged sources of the nation's wealth. Other improvements are continually being made, and the degree of advancement attained in the past is an earnest of progress awaiting future development.

Improvements in devices and methods of management and importing races of bees reputed to possess desirable qualities and characteristics have chiefly absorbed

the attention of American bee-keepers. It is not strange that reliance has been placed upon these resources as the means by which the best results were to be realized, rather than upon a persistent and skillful application of the laws of heredity and descent, and dependence upon the influence of intelligent selection and skillful crossing as a means for developing the highest attainable standard of excellence in the bee itself, which is the chief factor in permanent advancement.

Some preliminary steps have been taken in the matter of securing for importation some races of bees, whose value may be tested in their capacity as a species, or when properly crossed with races already introduced. But the very persistent efforts which have been made to improve the bees of the United States by yearly importations of the best races in their purity has been attended with serious drawbacks and hindrances. These bees, bred for countless generations under climatic and floral conditions different from those of the United States, are frequently submitted here to conditions of climate and methods of manipulation for which they are sometimes ill adapted. Any modification and adaptation of their habits, instinct, and physiological structure which may have been secured by breeding a few succeeding generations under the altered conditions incident to their cultivation in the United States have been, in a measure, lost with each fresh importation of ancestral stock, and the work of securing the variability and adaptability of instinct, habit, physiological structure, and functional capacity essential to their higher development must be begun *ab initio.*

Ever since the art of bee-keeping began to be practiced upon scientific principles the value of the exact knowledge and perfect control of the process of fecundation, and the consequent improvement of the bee itself, so as to increase the honey-yielding power, and thus advance the interest in the same way that the dairy interest has been advanced by improving the milk and butter producing qualities of the cow, has been recognized. No other branch of apicultural experiment possesses the same scientific interest and the practical value which success in this line would have is very generally admitted, hence it has long been the hope of every progressive apiculturist that some practical method of thus controlling reproduction might be discovered. With such control assured progress in scientific apiculture would be more rapid and permanent.

Much thought and labor have been expended in the United States upon experiments in this direction, and various methods and expedients have been adopted for securing the fertilization of queens in confinement, none of which, however, have proved entirely satisfactory. A full description of experiments which have been tried under my direction by Mr. Nelson W. McLain may be found in my reports as United States Entomologist for 1885 (p. 339) and for 1886 (p. 587).

Space will not permit me to go into details as to the progress made in the last twenty years in the United States in bee culture generally. It has been chiefly in the direction of improved hives and in mechanical appliances, such as extractors, comb-foundation machines, bee-smokers, and so on. In these directions, and in all appliances for saving labor and for facilitating the gathering and marketing of honey, I believe that the United States is preëminent, and the exhibit at the Exposition in connection with the agricultural products, and as indicated in the detailed catalogue, will show that many of the more important discoveries and contrivances of late introduced into practical bee-keeping are either of American origin or have been substantially improved by American bee-keepers.

CHAPTER XVIII

THE CEREAL PRODUCTS OF THE UNITED STATES.

By GEO. WM. HILL.

It is hardly necessary to impress upon Europeans the vast extent of our cereal supply. American competition has become a familiar term to the European farmer and American food products are equally familiar to the European consumer. Still, after all, while in many products we are always able to supply enough to keep down prices when short crops would, but for the American crop, find some compensation in long prices, so far as our cereal products are concerned we are known to European markets almost entirely by our wheat exports, of which in the past ten years we have sent 1,344,125,000 bushels, an average of 134,412,500 bushels yearly, across the Atlantic.

I will not trespass here at too great length on the field of statistics. A statistical report, prepared by Mr. J. R. Dodge, and forming one of this series, will be found to furnish ample food for reflection to those who are capable of digesting figures. I may be permitted to point out, however, an important feature in our cereal production, and that is the comparative uniformity of wheat acreage in recent years. This is the result solely of low prices occasioned by the development of new sources of supply, India, South America, and Australia all having thrown their respective surplusage—in no case very large but in the aggregate large enough to prevent a shortage—on the markets of the world, thus keeping down prices. The pioneer farmer in our Northwestern States, still continues to be a wheat-producer for obvious reasons; in the older, more settled States, other crops are found more profitable, and the average American farmer having no landlord and consequently no lease binding him to certain rotation, etc., changes his methods with comparative promptness, according to the exigencies that confront him. It is a fallacy to suppose that in any State wheat is abandoned because it can no longer be grown. This sometimes occurs as a temporary condition in sections which have for years been devoted to exclusive wheat-raising by the first settlers, but rest soon restores to the exhausted soil its wheat constituents. For instance, in Illinois, twelve years or more ago, the crop of wheat had come to be comparatively insignificant, yet in 1879 it reached figures (51,110,502 bushels) which have never but once been exceeded, and that in 1887 and by Dakota, a Territory that in 1880 boasted of but 17,000 farms and a total wheat crop of 2,830,289 bushels. Another point: At present careless farming is rewarded with a wheat yield averaging about 12 bushels to the acre, but the beginning of a better system is drawing near, and when land values increase by reason of settlement, the result will inevitably be to secure such improvement in the system as will double the crop

of each acre. As to the quality of our American wheat product not much needs to be said; it is attested by the quality of the flour manufactured by American millers and by the very material increase in our flour exports, an increase which is bound to go on until the great bulk of our wheat exports will be in that most economical form. Careful analyses of American grains have been made and the results given, not only in the valuable report on cereals prepared for the Census of 1880 by Prof. W. H. Brewer, but in the bulletins of the Connecticut agricultural experiment station, issued by Prof. E. H. Jenkins. While these analyses have made it quite clear that the estimate of quality, based solely on appearance, was unreasonably high and the estimate of quality based on its constituent elements, as tested by chemical analysis, was unreasonably low, this state of things is destined to ultimately change. In the meantime it is important, not less for the millers of the world than for the American producers, to secure such analyses of foreign grains competing with us in the European markets as will incontestably prove the respective values of the foreign and home grown grain. As the really successful farmer of the future will be the man who, to industry and business-like system, will superadd practical scientific knowledge whereby he may secure the largest returns for the smallest outlay, so the successful miller will be he who calls science to his aid in determining the comparative nutritive value of the various grains, and, thus informed, skillfully blends the product so as to produce the most perfect flour.

Cost of transportation, though still the great dread of the farmer, is being so reduced by competition and increased facilities, due to the inventive genius of man, that it will play a less and less important part in the great question of marketing our grain. Nebraska will soon be nearly twice as near to Liverpool as it was only five years ago,* and to the advantage thus obtained by increase of transportation facilities must be added that of reduced bulk, for, with all the certainty of the law of gravitation, breadstuffs for export must in the future occur in the concentrated forms of flour and other preparations from grain of which our markets are yearly showing a greater variety.

With the development of cereal production in Dakota, Montana, Oregon, and Washington the utilization of the Great Lakes as a means for cheapening transportation is bound to greatly increase. The railroads which penetrate the vast belt covered by the enormous Territories, so soon to be new States of the Union, bordering on the British possessions, all have or are seeking a terminus at Duluth, and last summer saw the inauguration by "The Northern Steamship Company" of such improved facilities in the way of steamship navigation as must necessarily have a marked influence in the direction I have indicated. This company has put on the lake service steel steamships of about 3,000 tons burden, equipped with every improvement known to our modern commercial marine, which make the trip from Duluth to Buffalo with great regularity in four and a half days, and the owners of which declare their ability to carry grain at a fair profit for 2 cents a bushel. I have thought this an indication of an important movement worthy of a special place in our cereal exhibit, and to this end have secured photographs of two of the steamers of this new line, with some interesting particulars concerning them, and these will therefore be found exhibited in connection with views of Dakota wheat fields, with which they are so closely allied.

The unfortunate tendency of Western towns and cities to "boom" everything connected with them has laid Americans open to the charge of boastfulness, but it is impossible to give information without stating facts, and it is patent to every unprejudiced and intelligent observer who has traveled in America that it is quite impossible to state the facts about American production and resources without using big figures, which of themselves give to strangers an appearance of boastfulness. I

*In 1884 the price of wheat in New York being 85 cents, it was 42 cents on the farm in Nebraska, while in 1888 the price in New York being $1.10, it was 85 cents on the farm in Nebraska; difference in 1884, 43 cents; in 1888, 27 cents.

FIELD OF CORN IN SHOCK, CLINTON, MISSOURI.

venture thus to premise what I shall say in regard to American cereal production to assure those who may peruse this report that what I may say is offered simply in compliance with the duty imposed upon me to give information and not in any spirit of brag.

The cereal production of the United States exceeds 50 bushels per head of population. Its consumption, though exceeding that of Europe as 40 is to 18, partly, no doubt, owing to extravagance and waste, allows of a considerable export, always capable of being greatly increased in response to a slight increase in price, for the very reason that our home consumption is excessive. With cost of production being steadily reduced by reason of improved methods of cultivation and the better farming, which means a greater yield, and the reduced cost of transportation, to which I have already alluded, the ground for consolation of our European brethren is to be found in the certainty that the masses of their people, if they choose to avail themselves of our resources, will be better fed; very high prices for food products, except in a season of unusual famine, a most unlikely contingency, being rendered well nigh impossible. It must be borne in mind that even our well-settled States are, by comparison with European countries, very little settled; that in many even of our older States the productive area is susceptible of being doubled—in some of those States now in the front rank as producers and exporters of our cereal products, of being trebled, in the newer fields of the extreme West and Northwest, of being quadrupled and quintupled—while in the Southern States, for reasons obvious to anyone familiar with the history of the past thirty years, we have a territory almost unexplored, as far as the possibilities of its productiveness in the line of human food are concerned. These statements refer, moreover, solely to area, taking no account of the increase in yield bound to follow a more careful system of farming, a system only postponed by an almost unfortunate wealth of land. In the meantime, fortunately for themselves if not for their European competitors, our farmers are daily becoming more thoughtful as to the methods of farming, and a frequent experience in the reduction of price which invariably follows the overproduction of any article for which the world's markets furnish only a certain demand, sometimes resulting in a smaller aggregate value for a larger aggregate crop, is teaching them to limit their productions of cereals and seek in more diversified farming better immediate returns for their labor and greater benefit to their land.

It would be interesting, if it were possible, to give some reliable figures on the cost of production of the cereal crops of the United States. The difficulty of doing so is well stated by Prof. W. H. Brewer, who, in compiling his wonderful array of interesting information for the Census of 1880 on our cereal production, found himself confronted with this most serious and difficult task. What he despaired of doing, with all the facilities and information at his command, it would be foolhardy for me to attempt. In this country conditions are so variable, the price of land covers so wide a range, the methods of calculation are so crude and diverse, and in so many cases is that important feature of farm economy, farm accounting, so utterly neglected, that the information obtainable is usually so unreliable that it is generally wiser to withhold than to impart it. Another difficulty arises from the fact that among those farmers who are guilty of keeping a cashbook and a careful system of accounts, the conditions under which they farm, taking, for instance, some of our mammoth Dakota farms, or some of the large stock farms in our central Western States, are so different from those of the average farmer, that their figures would give exceptional, not average, results. Again, in most cases we have found their calculations to have been based not on the cost of tillage per acre, but on the cost of raising a bushel of this or that kind of grain. I have, however, known an intelligent farmer in Dakota to declare that he could raise wheat at a cost of less than $4 per acre, and one equally intelligent and in the same neighborhood to as positively assert that he himself, with equally good management, lost money if his

wheat fields failed to yield him at least $7 an acre. I have known an Illinois farmer to figure himself out a loser on a yield of corn of 38 bushels to the acre, selling on the farm for 27 cents per bushel, and a farm-owner to declare his ability to prove that his tenants could make money on corn at 25 cents a bushel with a yield of 25 bushels to the acre. As a matter of fact, the average farmer in the cornfield is not losing money with the average price of corn 40 cents per bushel and the average yield 25 bushels to the acre;* and many a farmer will continue to raise wheat even though his crop will not bring him over $9 an acre.

Consideration of the resources of the United States in cereal production would not be complete without reference to the very important feature presented by the increasing utilization of the cereal crops, whereby additional value is given to the product of every acre. This additional value has necessarily the effect of reducing the percentage of cost of production to crop values, and in that light may be regarded as an increase of production. The application of science in the utilization of raw products has of late years made rapid progress in the direction of utilizing the parts of the product hitherto regarded as wastage. While this has been notably conspicuous in our mineral and metallurgic industries, it has been pursued with equally good results with reference to agricultural products. The value of wheat bran, for instance, has been shown to be far greater than it was supposed to be in years past. The scientific investigations pursued at several of our experiment stations, with a view to determining the relative value of various products as feed for stock, have indeed shown conclusively that, properly blended with other material, there is a very insignificant part of any crop grown that may not be made available as part of a cattle ration. In the case of straw, its habitual destruction has been due principally to habitual careless wastefulness, its value having been well established in the old country for years past; but it is only in recent years that it has been so thoroughly understood in this country, and that the growth of the live-stock industry in the West has brought the "straw pile" to the front as a product too valuable to be neglected or destroyed. In the case of corn fodder carelessness was abetted by an ignorance which our experiment stations have only just succeeded in dissipating, and the results of practical experimenting in this direction have been as astonishing as they are important in determining the value of the crop. So it is with the wonderful availability of corn in its successful utilization in a variety of ways as human food and in various other forms having a market value, such as starch, glucose, grape sugar, and lastly oil, of which a sample is included in our cereal exhibit, and which is made from the germs of the kernel extracted, and hitherto wasted; in the production of hominy and other products where the elimination of the yellow color imparted by the germ was essential. The gentleman from whom this sample of oil was procured asserts that from every bushel of corn so treated by him two pounds of oil are extracted, which he sells at 6 cents per pound, thus adding 12 cents to the value of each bushel.

Appended to this report will be found some of the analyses showing the value of a few of what may be termed "waste" cereal products, taken from the census report, and others furnished to the writer since by Dr. E. H. Jenkins, vice-director of the Connecticut agricultural experiment station at New Haven, Connecticut. I have already alluded to the reasons why our wheat crop shows a comparatively stationary area, notwithstanding the enormous development of the country, and at this writing Mr. J. R. Dodge, the able and experienced statistician of the U. S. Department of Agriculture, having kindly afforded me the privilege of looking over the advance sheets of his annual report, I find that the area of wheat the past ten years

* The corn yield for the past decade has been a fraction under 24 bushels to the acre, but for the previous decade it was 27.1, and the average for a period of twenty years would slightly exceed the figure I have given above. The average price, though variable during the decade ending in 1888, has been 40.8 cents.

has varied comparatively little from 37,000,000 acres. On the other hand, corn shows an increase of area in the same period from 62,000,000 to 75,000,000 acres, while that of oats has increased from 16,000,000 to 26,000,000 acres.

The area of barley shows an increase of about 50 per cent, but even with this its present area will barely reach 3,000,000 acres, while rye and buckwheat together will not amount to as much.

The great increase in the oat crop is a reflection of the great increase in stock-growing, and is also due in a not unimportant measure to the great increase of oat-meal as human food. Twenty years ago its use in this way by Americans was almost unknown; ten or twelve years ago it was by no means common, while to-day it is almost universal.

FIG. 215.—Red River Valley farm view, Traill County, North Dakota..

THE MAIZE* CROP OF THE UNITED STATES.

The presence in our cereal exhibit of maize grown north of Fargo, Dakota, and in Vermont and Massachusetts, sufficiently attests the wide range of territory throughout which this valuable cereal can be successfully grown, without going into details showing how much is grown in each of the various States and Territories of the Union. Suffice it to say that of the thirty-eight States and eight Territories comprising the United States, outside of Alaska, only one State—Nevada—and four Territories—Montana, Idaho, Arizona, and Wyoming—are unrepresented in making up the Indian corn or maize crop estimated for the year just passed. We may, however, be permitted to remark in reference to these crop returns that two of the northernmost Western States—Wisconsin and Minnesota—and one Territory—Dakota—produce together more than Pennsylvania and New York combined, and, with the exception of Kentucky, more than any one State, save those which are widely known as our surplus maize States. This fact is of interest principally as refuting the impression, until recently quite common and by no means yet dissipated in many parts of our own country, that Wisconsin, Minnesota, and Dakota, especially the two latter, were not maize-producing sections. This is true only by comparison with the great maize-producing States immediately to the south of them. The average proportion of the crop shipped out of the country where grown is about 20 per cent, while less than 4 per cent, usually not more than 2 per cent of it, finds its way into foreign markets. This very clearly indicates that the consumption of maize in its various prepared forms and as human food is hardly yet devel-

* In deference to European ways, we abandon the use of the word "corn" as applied to Indian corn or maize, and adhere to the latter name exclusively in the present report.

oped. There is every reason for the appellation frequently bestowed upon this great cereal crop in this country of "King Corn." Not only is it more valuable in the aggregate than any other single crop raised on the farms of this country, but its utilization is the most diversified. There is no waste in the maize crop; from the cob, which furnishes fuel to the prairie farmer, to the stalk and leaves, which provide him with most valuable feed for stock, every part of the plant above the ground is available for some useful purpose. Of late years especially have the millers turned their attention to the manufacture from maize of many different food preparations in addition to hominy, samp, and meal, which a few years ago embraced all the known food products from maize. To-day, in addition to these and to corn-starch, we have maizena, cerealine, and a number of other preparations, furnishing the American housekeeper with unlimited resources in supplying her table with healthful and delicious dishes suitable for every meal, and culminating in the most toothsome of puddings and dessert dishes. Considering the concentrated forms in which maize is now prepared for food purposes, it is surprising that these are not more commonly used in Europe. This can only be attributed to the ignorance existing on the other side of the Atlantic in regard to the various methods of utilizing this product for the table. Indeed, it is of record that the cargo of maize shipped by American charity to Ireland in the days of the famine was comparatively useless, simply because the famine-stricken people did not know how to cook it. The great use of maize as feed for cattle in this country has largely led to the impression among Europeans that that is all it is good for. Even in those sections of Europe where maize is grown, as the writer can testify from personal experience, but little use is made of this crop, and in the south of France only in the form of porridge or hasty pudding, and a not very palatable bread (reminding one somewhat, though very remotely, of Boston brown bread), is it ever seen on the table, and this principally in the houses of the peasantry.

It is to be regretted that adequate provision was not made for such an exhibition of maize prepared for food and properly cooked, at the Paris Exposition in 1889, as would have permitted every visitor to see for him or herself what a variety of tasty dishes, as nutritious as they are toothsome, can be produced by very ordinary culinary skill from this cereal, and we may be permitted to express here the hope that the enterprise of an American private citizen, Col. C. J. Murphy, of New York, in seeking to supplement this want, may be successful. Only by practical experience is it possible to convince our European friends of the availability of our maize crop in catering to the epicurean delicacy of their palates, the healthfulness of their stomachs, and the saving of their pocketbooks. The readiness with which Europeans who settle in this country avail themselves of a corn diet when once they know how to cook it affords ample testimony to the value of making an effort to introduce it as an article of food among the masses of Europe. Our capacity of production is practically unlimited, and an additional demand for export purposes of some five or six hundred million bushels would be not unlikely if once maize products were recognized as furnishing the cheap, nutritious, and palatable food that they do.

Of the sweet variety of maize we need say little here. Its use in this country is as a vegetable, and as such it is used in large quantities, both in the fresh and canned form. The reference to it made in the excellent report on vegetables, prepared by Mr. M. G. Kern, special agent, presents the facts in regard to the sweet corn used in the canning trade.

Pop corn is used very extensively in America, but exclusively as a cheap luxury, and though in the aggregate the consumption must be enormous no record is available by which the value of the crop can be estimated. Growing as it does in almost every part of the Union, its consumption is local and consequently, unlike the peanut, it is not shipped in any quantity. It is not unlikely that its introduc-

tion to the juvenile portion of the population of Europe would develop a very considerable demand for it, the fun of "popping" being quite equal to the gratification of eating. Samples of pop corn both raw and popped will be found in the cereal exhibit.

Before closing this chapter on maize, I may observe that it is being less used than heretofore as an exclusive cattle and hog diet, although it will always remain one of the most valuable adjuncts in stock-raising. Indeed, since ensilage has come to be one of the recognized articles of cattle feed and maize can be grown for this purpose in the extreme north of the United States, being cut before the grain is fully matured, it is not unlikely that the acreage in maize for cattle-feeding purposes may be largely increased without, however, resulting in a corresponding increase in the grain product. In this country ensilage is almost exclusively confined to maize fodder, but as in that form it properly comes within the section devoted to forage plants and grasses, I will not refer to it at greater length here.

In concluding this chapter on maize, I may offer a word of explanation as to the term "corn belt" as applied in this country. Measured by degrees of latitude it may be said to be between the thirty-seventh and forty-third parallel and west of the eighty-first meridian. To limit it on the west would, in the light of the past decade, be a little hazardous, although it is more than probable that a great surplus will never be produced west of the one-hundredth meridian. Measured by State limits we might regard the "corn belt" as included principally in Ohio, Indiana, Illinois, Missouri, Iowa, Nebraska, and Kansas, States which last year produced, in round numbers, 1,280,000 bushels out of a total crop of 1,988,000.

The value of last year's crop, estimated on the basis of present prices (March 1), would be $635,211,086; on the basis of December prices, $677,561,580. Over 1,200,000 bushels having gone into consumption before March 1, it would probably be safe to estimate the value of the crop of 1888 at not less than $650,000,000 and this at a lower average price than has prevailed for some time and far lower than the average for the last ten years. For the last five years the value of the maize crop has approximated the last-named figure, excessive yield being usually accompanied by a reduced price, and *vice versa*.

In the cultivation of maize the following are the chief characteristics sought by the grower: Depth and uniformity of kernel, lightness of cob, a long ear well covered from butt to tip, prolific yield and, in the Northwest especially, early maturity, in order to save the crop from the consequences of frost while still in the milk. This latter desideratum has been frequently obtained in northern Illinois, Indiana, and other sections by the great increase in tile drainage, whereby the season is practically lengthened by at least two weeks in the earlier planting which is thus rendered possible. In the exhibit of maize I have endeavored, except in the case of some of the sweet and of the pop varieties, to invariably show a section of the ear along with the full ears, in order to show the relative thickness of cob to depth of kernel. As an evidence of the improvement made of late years in this direction, it is worth noting that at the "Corn" show held last January under the auspices of the Nebraska State Board of Agriculture, the principal samples of which, by the courtesy of the secretary, Hon. R. W. Furnas, now form part of our cereal exhibit, the test showed corn as high as 60¼ pounds and cob as low as 5¾ pounds to the bushel, the legal bushel being 56 pounds corn, with 14 pounds of cob. For sweet or sugar corn the legal bushel is 40 pounds; at the Nebraska exhibit there were samples that weighed 51¼ pounds. The time required for maize to mature varies exceedingly, the average time for the sweet being about 70 days and for the field or hard varieties 95 to 110 days. Among the specimens shown in our exhibit, however, is a Minnesota Flint corn grown in Marshall County, which matured in 88 days, and it is claimed that a variety known as the Dakota Dent has ripened in 80 days

and the Mercer Flint in 70 days. As to the most popular varieties, I may premise that many of those known by different names in different sections are unlike more in name than in essential characteristics. At the same time such marked improvements have been obtained by careful growers, by selection and propagating some particular variety, as to justify some special designation. One of the duties devolving on our Experiment Stations is to try to properly and scientifically differentiate the various sorts now on the market under a great variety of names and reduce a little order out of the chaos of nomenclature with which not only our maize but most of our other cereals are affected. This "embarassment of riches" in the matter of names would make an enumeration of varieties by name a comparatively valueless addition to this report, and as it is designed to accompany the exhibit I would suggest that an examination of the specimens exhibited bearing the names and places of growth will afford the most satisfactory information in this particular. (Plate XXX gives a characteristic view of a full shock of corn, from a photograph taken at Clinton, Mo.)

OTHER CEREAL CROPS IN THE UNITED STATES.

As I have already pointed out, the area of our wheat crop does not greatly vary. In 1880, with an area of 35,430,052 acres the crop amounted to 459,479,505 bushels* and its value was $310,912,960. While the acreage has not greatly varied the yield has been as low (in 1885) as 357,000,000 bushels and as high (in 1884) as 513,000,000, in round numbers, the average being for a series of years about 450,000 000, and the average home consumption 315,000,000, or 261,000,000 bushels for food and 54,000,000 for seed. The export has necessarily varied greatly, the lowest in the present decade being 94,565,794 bushels in 1885, and the highest 186,321,514 bushels in 1880; the average export has been during the same period 133,515,735 bushels. Over 50 per cent of the wheat crop is distributed beyond the county lines. The fluctuation in price depending as it does on the foreign demand and the extent of the crop, has also greatly varied, the highest average price in the past ten years having been $1.19 in 1881, and the lowest 64½ cents in 1884. The most noticeable features in our wheat crop are the low average yield per acre, less than 13 bushels, and the tendency of wheat exports in the grain to diminish, and of wheat exports in the form of flour to increase—an increase which seems bound to continue. Improved milling methods have also contributed to this increase and have greatly added to the value of our spring-wheat crop principally grown in the Northwest, Minnesota and Dakota especially.

The great bulk of the wheat crop exported causes the crop to be very readily affected by the question of transportation, and the tendency in this direction is to constantly increasing facilities and to decrease in rates.

The increase in the wheat crop of the Northwest is bound to continue for many years, and it is noteworthy that in 1887 Dakota was credited with the largest wheat crop ever yet raised in any single State or Territory—nearly 12 per cent of the entire crop. The pioneer farmer in the wheat-growing sections invariably places his main reliance on his wheat crop, and this condition is bound for many reasons to continue. I have already spoken of the value of the chemical analyses applied to our wheat-crop product, some of which will be found in the form of an appendix to this report, and I will on this subject merely quote Prof. Brewer's very just observation on the relative importance of appearance and chemical composition. He says in his census report, already referred to:

"The nutritious character of flour depends upon its chemical composition, but

* The American bushel is the Winchester bushel, containing 2,150.42 cubic inches. The standard weight for a bushel of wheat is 60 pounds.

its market value depends as much upon its appearance as upon its nutritive qualities."

In 1880 Prof. Brewer remarked that over 83 per cent of the wheat crop was grown between the thirty-seventh and forty-fourth parallels, the principal wheat fields above forty-four degrees being in the Red River Valley, Washington, and some parts of Oregon, and below thirty-eight degrees, in Missouri, Kansas, and California. The great development of Dakota and the increase in settlement of Montana and Washington have already brought about a considerable modification to this statement and promise still greater change in the near future. The increase in the value of the hard spring wheat already referred to, due to the improved methods of milling, encourage the production of wheat in the extreme Northwest, coupled with the facilities afforded by the great Minneapolis mills with their enormous annual production * and the extension of railroad facilities.

We may confidently look for a large increase in the per cent of yield in the near future. In Ohio this has already taken place, as the figures for the past ten years indicate. While the demand may not justify an increased aggregate yield, an in-

FIG. 216.—Red River Valley farm view; harvesting in Traill County, North Dakota.

crease of yield per acre, as land becomes more valuable and careful farming the rule and not the exception, is certain and will release a percentage of the present wheat acreage for profitable use in other directions. Our Canadian neighbors have shown a yield per acre of 23 bushels, and that American farmers can, if they will, equal those figures, there is no doubt. At the same time, for many reasons, it is desirable that the wheat crop of the United States should be reduced, and I think it will be. In the first place, the various sources of wheat supply are increasing, and doubtless will continue to increase while the demand, while not stationary, can be approximately calculated in advance. From Australia, Chile, the Argentine Republic, Canada, Egypt, Russia, and British India the supply will doubtless be increased, and facilities of transportation will place this supply in the markets of those countries where there is a deficit, with less and less expense. In some portions of the United States wheat-raising will be for many years to come almost a necessity; but with the price of wheat thus depressed, except in the years of general deficiency of yield, and these must necessarily be of rare occurrence, owing to the

* The number of barrels of flour turned out by the Minneapolis mills in 1888 slightly exceeded 7,000,000, the aggregate value being, including offal, not less than $35,000,000.

large extent and world-wide distribution of the surplus wheat-producing countries, wheat-raising for export must necessarily be confined to those sections where the cost of its production is reduced to a minimum. The development of wheat-raising reached in the Northwest is still in its infancy, and it would be difficult to prophecy the extent of it, say, ten years from now; but the farmers of the central and central Western States must learn ere long that a restriction in the wheat acreage is their wisest policy, and that a wheat crop ample to supply our enormous and rapidly growing home demand and leaving but a small surplus for export will ultimately result in securing as large cash returns from an area of 20,000,000 acres, with an average yield of 20 bushels to the acre, as from an area of nearly 40,000,000 acres with an average yield of 12 to 13 bushels.

For reasons already stated, I need not offer to European readers any detailed account of our methods of wheat cultivation, from which they have nothing to learn, and which, with the exception of those sections where irrigation is practiced, offer no special features of interest.

Of the spring wheats, the Scotch Fife, generally among seedsmen quoted as "Saskatchewan Fife," is the most common and the most popular, as are the Fultz,

FIG. 217.—Harvesting scene, Red River Valley, North Dakota.

the Mediterranean, Clawson, and the Martin Amber among the winter wheats. The Tappahannock is pronounced by some to have the advantage of being a specially early variety, thus escaping rust.

The Fife wheat was introduced into this country from the British Dominions through the courtesy of Mr. Alexander Begg, the then minister of agriculture of Manitoba, who furnished Mr. Abermethy, a St. Paul journalist, then visiting Winnipeg, with the names of farmers in the Saskatchewan growing the best grains. The wheat thus obtained, some of it from Prince Albert, on the North Fork of the Saskatchewan, was shown to a number of expert judges, the wheat inspector at Minneapolis, Mr. C. A. Pillsbury, the great miller, and others, and by all pronounced to be a very superior grain. As to the yield and weight the Canadian growers gave wonderful accounts, 40 bushels to the acre being reported as not uncommon, and the weight sometimes reaching 65 pounds to the bushel. One of the best samples of this wheat was given to Mr. D. L. Wellman, of Frazee City, Minn., who sowed it in the spring of 1879 on a piece of hazelbrush land which had been broken the year before, was backset in the fall, and had become thoroughly rotted. The following spring Mr. Wellman sowed the seed on another piece of new, clean ground. Just before harvesting the ground was gone over foot by foot, and every head of bearded grain or soft wheat that had been overlooked was pulled

WHEAT HARVESTING.

up by the roots and destroyed. The yield that year was 37½ bushels to the acre, the grain weighing 62 pounds to the bushel. In 1881 Mr. Wellman was able to sow several acres, and in spite of an unpropitious season the yield was 25 bushels to the acre; and the grain from this crop, being shown at the great Northwestern Fair at Minneapolis, elicited the highest commendation from the committee on grains. The great popularity of this Scotch or "Saskatchewan" Fife is due to its thriftiness, its early maturity, and its prolificness.

The now very popular Fultz wheat was introduced by the U. S. Department of Agriculture at Washington many years ago.

The greatest trouble with our farmers, especially in the new sections, is the sowing of impure, dirty seed, which, together with continuous cropping and the exhaustion of the soil incident thereto, speedily reduces the acreage yield. It is doubtless to these causes also that are attributable the impressions which frequently obtain that the wheat deteriorates. Of the insect pests and the diseases with which our wheat and other cereals are afflicted, I shall speak briefly in a paragraph by itself. (An additional wheat-harvesting scene is shown by Plate XXXI.)

The production of oats is even more generally distributed as regards latitude than either maize or wheat. One of the peculiarities of the oat crop in this country is that it is lighter in weight than in most other countries where it is an important crop. The legal weight of a bushel of oats varies in different States from 26 to 36 pounds, 32 pounds being the most common. In many cases oats are reported as weighing as high as 40 pounds, and in some cases as high as 50 pounds, but the average is much less, the lowest being down to 25, and even in a few cases to 20 pounds. In cooler, moister climates than the United States, as in Scotland or England, the weight seems to be greater. Among other signs of progress is the increased appreciation of straw in this country as cattle feed, and for this purpose oat straw is considered more valuable than that of wheat or barley.

I have already alluded to the great increase in the use of oatmeal in this country and to the fact that this has no doubt played an important part in the immense increase in the area sown to oats, the other factor in bringing about this result being the increase in our live stock and the higher value now set on oat straw as cattle feed than formerly.

The increase of the oat crop in the Northwest is bound to be very considerable. In the first place the climate is propitious and the development of our live-stock industry in that section remarkable; especially is this true of that class of stock for which oats are the most popular food, namely, horses. Moreover, more careful farming induces the practice of rotation in crops, and oats are certain to find a place in any rotation adopted in the Northwest. The oats produced in Montana, Washington, and Oregon are of extra weight and quality.

In reference to the favorite varieties, inquiries from leading seedsmen indicate the following as the most popular, in about the order named: Welcome, Red Rust Proof, White Russian, Probestier, White Belgian, Black Tartarian, Burt's Extra Early, Rust Proof, and Salzer's Bonanza.

The increase in the oat crop since 1880 has been remarkable, the area having increased from 16,187,977 acres in the former year to 26,998,282 acres in 1887, while the crop increase in the same time was from 417,885,380 to 701,735,000 bushels.

In reference to the cultivation of the oat crop, while there is no doubt that a great many farmers, in the West especially, are sadly lacking in their methods of cultivation not only of this but of every other crop, yet the advance made in the last ten years all along the line justifies the assumption that, as in the case of all other farm crops, more intelligent and careful methods will be common ere many more years roll by to the great bulk of western farmers. Not, perhaps, that all who are now farming in the West will have become systematic and intelligent, but that those who have failed to become so will have been compelled to drop out of the ranks altogether.

The foregoing, namely, maize, wheat, and oats, embrace by far the largest portion of American cereal productions, they alone supplying 50 bushels of grain per inhabitant. By comparison with them our crops of barley, rye, and buckwheat, aggregating less than 80,000,000 bushels, are insignificant, though taken by themselves they represent a considerable value. The special feature of the barley crop of the United States which seems to strike the observer very forcibly as deserving notice, is the fact that of this cereal alone are there any importations of any consequence into this country, our Canadian friends sending us each year some $7,000,000 or $8,000,000 worth. Under the circumstances it is not strange that our barley crop does not grow to very large proportions. The statistics of the U. S. Department of Agriculture, however, show that the increase even in this comparatively unimportant cereal was from 45,000,000 bushels, in round numbers, in 1880 to 57,000,000 in 1887, the area in the same time increasing from 1,843,329 to 2,900,953 acres. The Canadians owe the American demand for their barley to the alleged superiority of their grain for brewers' use.

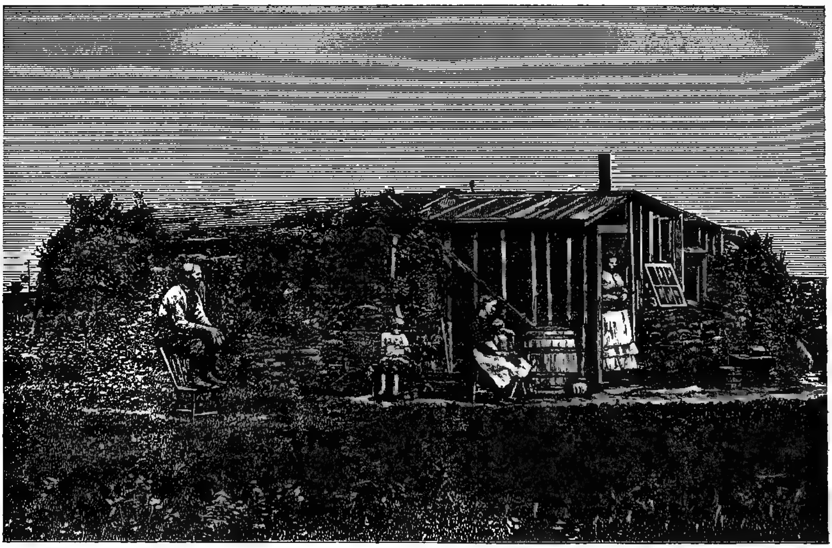


FIG. 218.—Home of Dakota settler.

Rye showed an increase in the area between the dates last given from 1,767,619 acres to 2,053,447, an increase just about corresponding with the increase in our population in the same time. The crop yield, however, shows a falling off, and contrary to the usual rule the value, instead of increasing with the reduction of yield, shows an even greater falling off, the value of the product per acre in 1880 being only $5.49.

Buckwheat is comparatively little grown, its total area in this country being less than 900,000 acres and the value of the crop less than $7,000,000.

Efforts are being made by some of our most prominent seedsmen to introduce a variety known as "New Japanese Buckwheat," having a very large kernel, ripening early, very prolific. Those who have tried it speak of it very enthusiastically, among them being several prominent bee-growers.

Since this report was begun it has been my good fortune to receive some data on the cost of growing grains in North Dakota from a gentleman who keeps a thorough system of accounts on his large and well-managed farm, Mr. J. B. Power, of Power, N. Dak. Additional interest attaches to these figures in connection

with the present report from the fact that it was on this, the Helendale farm, that the studies were made from which Mr. Carl Gutherz painted the large picture, "Farming in Dakota," which accompanies the exhibit to Paris.

The following figures are submitted by Mr. Power as the cost of raising 580 acres of small grains:

Kind of grain.	Acreage.	Yield per acre.	Total yield (machine measure).
		Bushels.	*Bushels.*
Wheat	250	15	3,750
Barley	90	23⅛	2,110
Oats	240	24	5,760
Total	580	....	11,620

Average of combined crop, 20 bushels per acre. (Machine measure usually overruns in actual quantity, so that cleaning for market does not reduce measured yield.)

Cash paid, labor:	
Seeding	$57.00
Harvesting	208.00
Thrashing	268.00
	533.00
Boarding men	226.00
Boarding horses *	675.00
	901.00
Repairing machinery and extras	262.00
Twine	145.00
Seed, market price (raised on farm the previous year)	520.00
Paid labor, stubble fall plowing	233.00
	2,594.00
Average cost:	
Per acre	4.47¼
Per bushel	.22⅛
Cash cost per bushel:	
Wheat	.2981
Barley	.1908
Oats	.1863
Sold net at farm:	
Wheat	.75
Barley	.47
Oats	.20

	Total.	Average per acre.
Money value of crop	$5,244.20	$9.04
Money cost of crop	2,594.00	4.47¼
Net credit	2,650.20	4.56

Mr. Power makes here the following note: "Wheat was injured by blight, reduced in quality to No. 3; if No. 1, as it always has been until this season, it would have sold at $1 at farm. Barley was from some cause reduced to low grade No. 2; if of quality usually harvested it would have brought 55 cents. Oats were similarly re-

*In this item I have put in money value of oats raised on the farm the previous year.

duced over 50 per cent in yield and 5 to 10 cents in value less than for past two years." "For this 580 acres of cultivated grain land," he adds, "I have some 320 acres for pasture and hay land, the 900 acres, including value of buildings and other improvements, worth, say, $15 per acre, or $13,500; interest at 8 per cent, $1,080; taxes $215, equals $1,295. Now from the crops of the poorest year we ever had in Dakota you can pay a tax of 1½ per cent on full valuation, pay yourself 8 per cent on full value of property, and have a surplus of $1,355.20 out of which to pay interest on value of live stock and machinery to run the farm. The figures I give you are money outlays at cash values of feed. I make no charge for interest on land nor for depreciation of machinery (the money outlay for repairs and extras keep the machinery in such order that it does as good work as when new, and being as good as new to me I do not charge any part of it off).

"Every farmer that keeps books of accounts keeps them to suit his own ideas; my way is to so keep them as to know at the end of the season the cash cost of cultivating land after you get it. My real-estate account is charged with first cost and taxes and credited with profits of cultivation in case of profit, or debited with loss, if any.

FIG. 219.—Home of Dakota settler.

"In using my figures in connection with your report, bear in mind that a maximum average crop will add to the yields of this season from my fields fully 25 per cent, without increasing cash outlay a dollar, except in items of thrashing, harvesting, and feed of horses, that might in that case be increased by 10 per cent of the figures now given.

"I attach especial importance to the figures as given here of the cost of cultivation per acre, the yield of course being variable and a good yield usually, though of course not invariably, resulting in lower prices. In charging interest on the entire valuation and all the taxes to the cereal crop, it must be remembered that the increase of the live stock is left as another source of profit, and that there is sold from this farm other products, such as cattle, colts, wool, and occasionally dairy products."

In regard to the diseases threatening cereals in this country, not much need be said for the information of foreigners, the diseases common here being what most

of them are familiar with in their own country. Mildew or rust is probably the most serious trouble we have in the way of diseases common to the cereals. It is due to the hot, muggy, damp weather not uncommon in this country. Smut is also common enough. Corn is the least liable to disease of any cereals we have. The most serious damage to our cereal crops is caused by insect enemies.

The facts regarding our rice product are very completely covered in a report on rice culture in South Carolina, especially prepared to form part of this series, by Milton Whitney, professor of agriculture, University of South Carolina, Columbia, South Carolina.

CHAPTER XIX.

RICE CULTURE IN SOUTH CAROLINA.

By MILTON WHITNEY.

The cultivation of rice was probably introduced into the United States about the year 1693, by Thomas Smith,* who planted it on the present site of Charleston, South Carolina.

It was probably first cultivated on the upland, then in swamps, and later the present system of water culture was introduced by "Gideon Dapont of Great James Goose Creek, an experienced planter of sound judgment, who after repeated trials ascertained its practicability and great utility," † who in 1783 petitioned the legislature of the State to grant money for the project. A committee inspected and approved his plan, but as there was no money in the treasury a patent only was granted him the next year, which was scornfully refused. However, Burham writing ten years later, ‡ in speaking of the luxurious easy life of the planters of the coast region, incidentally mentions the cultivation of rice by irrigation as though it were a common method practiced on a very extensive scale. Water culture or irrigation of rice, while not necessary for the production of the crop, reduces the cost of collection so as to make the production of upland rice when irrigation can not be employed unprofitable compared with cotton, save for family use. Upland rice is valued for seed by the coast planters because of its freedom from red or volunteer rice, which is such a pest under the water-culture system as to necessitate resting the land at times for a year or two to insure its destruction.

The rice plant is quite hardy and can probably be grown wherever wheat and oats are grown, and it is stated, as with other cereals, that the farther north the better the quality of the grain. It is said to have been grown successfully in England, Germany, and even in the colder parts of Siberia. It has been returned on the regular schedule of crops from our Northwestern States in several of the census reports, notably from Tennessee, Kentucky, Missouri, Michigan, and Minnesota.

The lower pine belt, extending from 80 to 100 miles inland from the coast, from Virginia down along the Atlantic and Gulf coasts, consists of a fine sandy loam soil with yellow sand or clay subsoil, naturally fertile and retentive of moisture and fertilizers, yet generally well drained, save in the vast swamps where the rank growth of vegetation forms an impervious mulch on the surface and chokes up all

* "An Historical Account of the Rise and Progress of the Colonies of South Carolina and Georgia," 1779 (page 118). Also Ramsey's History of South Carolina and other sources.

† Mills's "Statistics of South Carolina," 1826.

‡ "Travels through North and South Carolina, Georgia." William Burham, 1794, page 11.

carry at a load the product of 8 or 10 acres, averaging 2 or 3 tons of straw and grain per acre. After the crop is removed the fields are flooded for a few days to sprout shattered and volunteer seed, then dried off fifteen days or more, and this is repeated once or twice, especially on land infested with red rice and grass seed.

The upland river swamps offer certain advantages over the tide-water lands, in that the lower levees are not so expensive, as they do not have to be so strong and are more easily built, there being no tide to contend with. The drainage is usually greater, 8 to 10 feet, so that the land quickly dries up, allowing horses and teams to go on it in a few days after the water is let off and admitting the use of more machinery and horse-power to replace expensive hoeing. The water can be let on in a continuous stream during the harvest flow, and none of the flows are dependent on the tides, as canals come from up the river through the swamps. Teams are often used to cut the grain and haul it to the thrasher.

The yield of rice in the last census year (1879) was 20 bushels per acre as an average for the State of South Carolina, which produced nearly half of the total crop of the United States. The yield per acre on the best lands often ranges from 50 to 100 bushels. The total production of rice has fallen greatly in the last 30 years, as the following figures, taken from the Tenth Census, show:

Year.	United States.	South Carolina.
	Pounds.	*Pounds.*
1850	215,313,487	159,930,613
1860	187,167,032	119,100,528
1870	73,635,021	32,304,825
1880	110,131,373	52,077,515

While this decrease is doubtless due in part to foreign competition, made possible through cheap transportation, the recent overthrow of the whole social and political situation of these rice countries has had by far the greatest effect. A letter written by the Hon. A. P. Butler, commissioner of agriculture for South Carolina, sums up the situation very clearly in the following words:

"Rice lands have greatly depreciated in value. Before the war the rice lands of Georgetown County assessed higher than the lands in any other part of the State. It requires large capital to put a large rice plantation in proper condition for cultivation, and constant expenditure of money, time, labor, and expense to keep it so. The owners of these lands were not in condition to resume operations at the close of the war. Labor was disorganized and could not be controlled as formerly. The discovery of phosphates in the rice-growing region of the State and the establishment of turpentine farms took away many laborers, who received better wages for such work than on the plantations. All these causes tended to the depreciation of the rice lands, but lack of capital was the chief cause. The value has depreciated from $200 to $300 per acre in 1860 to $20 to $30 and less at present, while some plantations have been abandoned. There are still, however, some plantations in splendid state of cultivation."

It is estimated that "there are more than 2,000,000 acres of land, consisting of inland and river swamps and of fresh water and salt marshes, admirably adapted to rice culture, now lying unused in this section of the State (South Carolina), most of it in its original wildness."

There are signs that in the renewed energy, strength, and life coming into the South this industry will be built up as it should be; for Carolina rice, by long and careful selection and intelligent cultivation, has long had a prominent place in the markets of the world, and what is at present waste land will be taken up with its accumulated wealth of plant food to the improvement of the healthiness and general condition of that section of our country.

CHAPTER XX.

THE VEGETABLE PRODUCTS OF THE UNITED STATES.

By M. G. KERN.

Food plants, considered in their relations to botanical classification, are confined to a few of the natural families of plants recognized in the science of botany. The cereals (Gramineæ) overshadow in importance all other families, embracing the vast tribes from which all breadstuffs proper are obtained, and on which all domestic live stock, so closely linked to our food supplies, depend in great part for subsistence. Plants of nutritious properties, used in a variety of forms, not members of this family, are conventionally termed vegetables.

The pulse family (Leguminosæ) furnishes the nutritious grains called peas and beans, used extensively in the green and dry state. The family of Solanaceæ embraces the potato and the tomato. The esculent tubers of the former are, next to the farinaceous breadstuffs, the most important factor in the supply of human food, while the fruits of the latter are an indispensable relish in American cookery.

The Liliaceæ furnishes the onion. Our luscious melons, cool cucumbers, and gigantic pumpkins come from the family of Cucurbitaceæ. A great variety of the herbaceous vegetables entering prominently into the menu of every household belong to the family of Cruçiferæ, which embraces the cabbage, cauliflower, kale, radish, and turnip; lettuce and salsify to the Compositæ. Esculent vegetables vary widely in firmness of their tissue or lasting quality of parts used for food. The pulse grains, when used in the dry state as grains, are, like the cereal products, independent as to time of their consumption. When used in the green state of seeds and seed pods they are perishable, like other herbaceous truck.

Tubers, onions, and roots possess sufficient firmness to last for months after being gathered from the field, and are in consequence legitimate agricultural crops, commanding a certain commercial value in their season. The extent of their culture is for that reason not limited by the necessity of immediate consumption, but only by the demand existing for them, which, establishing the market value, decides the question as to what extent they can be profitably raised. Vegetables, the leaves, leaf-stalks, or tender shoots of which are used, and all juicy and ripe fruits, are perishable to more or less extent, especially in the warm months of the year, when they most abound. Their culture for commercial purposes is determined, therefore, by the market, in which they must find a ready sale to prevent their waste and loss to the producer or dealer. The culture of vegetables entering so prominently into the daily food supply of every household of the land is practi-

cally limitless, and the magnitude of consumption of this class of provisions cannot be reduced to actual figures. Each provident housekeeper controlling a patch of ground, whereon a part of the family supply can be grown, takes pains to make a garden, and this branch of gardening is quite well understood by everybody, almost by intuition. In all the rural districts, where the home production of daily wants is the cornerstone of rural economy, a large percentage of food consumed by the family comes directly from the garden to the kitchen. The homely and apparently insignificant plants from which this great volume of daily food is derived, represent, collectively considered, a greater real economic value than is generally credited to them. The urban population depends for the supply of fresh vegetables entirely on the new industry of the market gardener, and that industrious, painstaking tiller of the soil is at work in the outlying circumference of all towns and cities. His products are met with daily in the provision markets, but are considered withal as only an appendix to the general stock of daily provisions. They result, however, from a productive industry, of whose extent and financial importance no one seems to have a clear conception. In the absence of any statistical efforts to ascertain the real magnitude of this industry we have no figures approximately correct by which to estimate the amount of capital invested, the acreage cultivated, and the labor employed in this branch of agriculture or horticulture, or whatever the industry may be called outside the slang name of "truck-raising." A general idea may, however, be formed of the immensity of production and amounts paid for these supplies, if we consider what a mass of population must be daily supplied and that our people are proverbially the best fed of any in the world, food-relishes and luxuries being everywhere used, and the market of every town of any size being constantly supplied with fresh vegetables.

All products of the soil drift necessarily toward the great centers of commerce and population, creating for the United States a current of internal commerce unequaled by any other country on the globe. Fruit and vegetable provisions, in quantities commensurate to the needs of millions of population inhabiting the Eastern, Central, and Northern parts of the United States, are truly an important factor in the nation's trade, supplied by every section and latitude of the continent. The great cities of the Atlantic coast and the Middle States receive the earliest supplies of culinary vegetables from the subtropical shores of Florida and of the Gulf of Mexico weeks and months before these products mature in the vicinity of more Northern cities. This Southern crop, however, is merely the forerunner of the main supply furnished by the territory directly tributary to the great cities of the North and West.

The rapid development of this shipping trade in Southern products for Northern markets has practically divided the industry of market gardening into two distinct branches, *i. e.*, Southern and Northern vegetable culture. As such it is regarded by the grower and the shipper, and on this basis it will be reviewed in this connection

FIELD CROPS.

Beans and peas are extensively cultivated. They are highly nutritious grains, and for this reason are worthy of mention among the vegetable food crops. Many varieties of this family are grown for use in the green and tender state, and belong, as summer vegetables, to garden culture exclusively.

The most important variety is the White Navy bean, so universally known in the provision trade. The production of sound, well-formed, and normally ripened seed is of foremost importance in its culture. Climatic conditions unfavorable to the attainment of this object, or soils producing too rapid development of leaves and stock to the detriment of seed production, confine this crop mostly to the northern latitude of the United States, in which degrees of temperature and moisture of

atmosphere permit the normal development of the plant and the proper ripening of the seed. It is cultivated, nevertheless, to some extent in the Middle and Southern States, especially in the higher latitude of the Allegheny Mountain States, but the success of the crop is of necessity more uncertain than in the northern regions. The varieties named Marrowfat and White Kidney are varieties of a higher commercial grade, and are grown to a considerable extent, requiring, however, more careful culture and handling than is generally given to the crop. The bean crop succeeds as a rule on soils of less fertility than required by the majority of cultivated plants, and is raised on innumerable fields and stony hillsides on which no paying crop of corn or grain could be produced. If planted as a succession to a crop of grass or clover, there will be considerable saving of labor, owing to the comparative absence of a rampant crop of weeds from freshly inverted sod ground. The seed is drilled into rows 2½ feet apart. The drill deposits the seed in hills 15 inches apart in the row. This mode of planting is preferred to a continuous line of plants, on account of the ease with which the ripe crop can be pulled, which is done by hand. The stalks are left in small piles to dry before being housed or stacked, awaiting threshing. Wet weather at this season often does great injury to the crop, causing the seed to mold, and injuring the bright white color demanded in the trade. The dry hulls of the pods are fed to sheep. The accompanying statistical table of production (United States Census, 1880, the latest official record) will show the relative extent of bean culture in the States producing the greatest percentage of the crop.

	Bushels.		Bushels.
Illinois	64,000	New Hampshire	63,000
Indiana	41,000	New Mexico	16,000
Iowa	59,000	New York	1,303,000
Kansas	43,000	North Carolina	50,000
Kentucky	32,000	Pennsylvania	40,000
Maine	181,000	Tennessee	55,000
Massachusetts	21,000	Vermont	51,000
Michigan	167,000	Virginia	45,000
Minnesota	18,000	West Virginia	46,000
Missouri	90,000	Wisconsin	67,000
Nebraska	13,000		

The Cow-pea, a species of the bean family, is extensively cultivated in the Southern States, where it is one of the most valuable forage plants, and the best fertilizer of the land when plowed under in the green state, or later, when dead or decaying. The value of this plant to Southern agriculture cannot be too highly estimated, and the extent of its culture will increase in due proportion to the rapid development of a more enlightened and profitable system of agriculture in the Southern States. A table of production is quoted in this connection (United States Census, 1880), since which year a great increase can safely be assumed, viz:

	Bushels.		Bushels.
Alabama	414,000	North Carolina	907,000
Arkansas	193,000	South Carolina	726,000
Georgia	66,000	Tennessee	612,000
Kentucky	70,000	Texas	93,000
Louisiana	122,000	Virginia	77,000
Mississippi	675,000		

The culture of the pea as a commercial grain is greatly restricted in the Northern States, and even abandoned in many districts climatically well suited to the healthy growth of this plant, on account of the prevalence of the Pea Weevil, which damages the seed and unfits it for culinary uses. Some favorable localities, comparatively

few in number, have escaped thus far the attacks of this pest, and in these the plant is extensively cultivated, mostly for the supply of the seed trade of the United States. The greater part of the peas offered, both in the provision and the seed trade, is imported from northern latitudes, in Canada and Europe, from which this insect pest is excluded by climatic conditions. Table showing States producing the principal supply in 1879 (United States Census, 1880):

	Bushels.		Bushels.
Iowa	14,000	Pennsylvania	11,000
Maine	54,000	Vermont	23,000
Michigan	601,000	Washington	30,000
Montana	20,000	Wisconsin	201,000
New York	266,000	Utah	22,000
Oregon	35,000		

The Potato.—The great importance and value of the potato crop of the United States in an economic and commercial view is so generally conceded as to need no comment. This highly nutritious esculent, universally used in every household of he land, is cultivated everywhere, accommodating itself to all kinds of soil and all latitudes of the country. No food plant, except wheat and corn, is raised to greater extent for home consumption and for a supply of cheap nourishment within the reach of all than this tuber. Being a tuber grown below the surface of the ground the yield is in great measure determined by the degree of moisture of the soil, being greater in seasons of sufficient rainfall favorably balanced by dry weather, and smaller in proportion to the lack or excess of moisture in the ground. The development of the tuber depends, on the other hand, on the healthy growth of the leafy part of the plant, the stem or so-called vines. Favorable meteorological conditions are especially potent and governing in this respect, as the plant cannot endure excesses of heat, so prevalent in many sections of the country, without the loss of much of its inherent vitality, ending in premature exhaustion and decay of the tops, causing immediate suspension of the development and maturing of the tuber. In consequence of the operation of these uncontrollable laws of nature, the success or failure of the crop depends more generally on the uncertain vicissitudes of the weather than that of a majority of the leading agricultural crops. In the Southern and Middle States the earliest planted crops, maturing before the season of excessive heat (frequently accompanied by severe droughts) has set in, must necessarily be the safest, while favorable weather in the later part of the season will frequently produce the most abundant late crops.

The Northern, Eastern, and Northwestern States have a climate less subject in general to excessive dryness or heat, and an atmosphere holding a greater degree of moisture in suspense, owing to the influence of the ocean and Great Lakes of the North, and are favored in consequence by a more uniform sufficiency of rainfall than the central sections of the country, and there we find in consequence not only the greatest production, but likewise the highest grade of excellence of the product. But the most striking evidence of the influence of a cool atmospheric action and never-failing moisture of the soil is found in the Rocky Mountain States and Territories, where all crops are produced by the aid of irrigation. The monstrous size of the product shows plainly the possibilities attainable under circumstances most favorable to the growth and of the healthy action of the vine in the formation of the tubers. Although the plant accommodates itself quite easily to a great variety of soils and produces satisfactory crops when favored by suitable weather, there is nevertheless a wide difference in soils as to their special adaptability to successful culture and in the production of tubers of the highest nutritious grades. The difference is due to the physical condition and the chemical components of the soil. Light, porous, and well-drained soils produce invariably a larger percentage of starch or dry and palatable tubers, while wet, tenacious, and mucky soils will develop an undesirable amount of gluten, resulting in watery or spongy tubers.

The influence of the chemical composition of the soil is strikingly illustrated when the crop of a new and virgin plot of ground is compared with the product of the soil cropped for a succession of years with the same product. The potato requires a large percentage of mineral food for the formation of the tuber, and finding an abundance of the requisite salts in the virgin soil, the crop is correspondingly large, while the reverse is the case where these elements have been exhausted. Even the best soils will not produce good crops for many years if cropped without intercession. Frequent renovating of soil by rotation of crops, and resting of the land in grass or clover are indispensable. The most liberal application of manure on soils exhausted of their essential mineral components cannot produce a crop of tubers, a fact well known to the market-gardener. But change and rotation are necessary, not only in regard to soil, but also as to seed and varieties cultivated for a number of years. The theory and practical results of change of seed and of the superiority of seed grown in a northern latitude, are topics well known to every intelligent farmer. They hold especially good in potato culture. A good percentage of the crop grown at the North is yearly distributed throughout the country for seed for the next season's crop, and an extensive shipping trade is carried on in this direction by many of the leading seed establishments and provision firms. For change of varieties, it may be stated that continuous reproduction of a kind is always followed by a weakening or gradual disappearance of the natural vigor. This general axiom of vegetable physiology is fully verified in the potato tribe, in the culture of which a rapid change of kinds is continually taking place, owing in a great measure, perhaps, to the multitude of new and improved varieties brought to public notice. Some types, however, retain their individuality and vigor for a longer period than others, which accounts for the fact that some of the oldest are still the favorite kinds in many localities. A certain variety, however, may cease to be worthy of cultivation in one section and renew its vigor when changed to another, especially to a more northern section As an illustration, I mention the White Meshanick, long given up in many parts of the Ohio Valley, which to-day is one of the most profitable sorts in Iowa and farther north. The modes of culture in vogue in different sections and with different planters, although varying in detail, agree in all essential points, the most important being the proper selection and preparation of the ground.

The depth at which the seed is planted varies in accordance with the nature of the soil. In heavy soils, with a tenacious, undrained subsoil, the seed is covered lightly. In light and friable, well-drained soils, a heavier covering of the seed is generally preferred. Planting is done in rows 15 to 18 inches apart. In alluvial soils, subject to rampant growth of weeds, planting in hill, permitting plowing both ways, is preferred by some planters. With the appearance of the growth above ground the harrow and cultivator are freely used to suppress the weeds and to keep the ground in loose condition. As growth advances the stems are hilled up by turning a light furrow from both sides upon them. Opinions and experience vary as to dimensions of the ridges. Some experts preferring shallow, and others deep hilling up. Peculiarities of soil and seasons indicate the proper course in this regard. The same implements used in the cornfield are likewise applied to the potato rows. The trade, however, offers a variety of inventions to facilitate the work incident to the culture and digging of the crop. There are machines for planting and covering the seed, for hilling up the rows, and for raising the tubers out of the ground and separating them from the soil. Manure is largely used for fertilizing fields of limited extent. In culture on a more extensive scale the main dependence of the planter is in a judicious rotation of crops, following a crop of grass or clover by a potato crop. Fall crops of peas or rye plowed under in the green state are likewise an effectual preparation of the soil. Sowing the ground destined for the crop in rye in the fall preceding and plowing the green crop under before planting-time,

adds wonderfully to the fertility of the soil. This plan of green manuring is pursued by many planters. The use of super-phosphates is quite frequently resorted to with good results where fertilizing by artificial means is required. Potato culture requires a relentless warfare on the insect enemies of the plant, the most formidable of which is the Colorado Potato-beetle or "Potato-bug." A liberal dusting of the vines with Paris green applied several times during the growing season, according as the pest is more or less persistent, is the most effectual mode of riddance within the reach of every planter. The crop is also injured in certain seasons by wireworms and the scab malady of the outer rind of the tuber. There are, however, no very effectual remedies against these evils. The problem of the potato rot, so destructive to the matured crop has been so widely discussed by planters and scientists of both hemispheres that it is not deemed expedient to discuss it here.

The extent of the culture of this plant outside the crop raised for home consumption, varies widely in different sections. In many localities favored with suitable conditions of the soil and within convenient distance or communication otherwise with lively markets, a large area of land is cultivated for this crop. In districts remote from direct communication with the leading markets the culture for commercial purposes is naturally out of the question. In the belt of territory north of 42° of latitude the potato crop is one of the leading agricultural resources, and the basis of a shipping trade of vast dimensions. Extensive speculative ventures in this branch of husbandry are confined to localities favored, besides suitable conditions of soil and climate, by cheap and rapid transportation facilities, so essential in the shipping of this bulky and heavy product. A large percentage of the annual crop is transported by coastwise shipping along the Atlantic seaboard and by lake and river navigation. The crop of the interior sections remote from water transportation is moved by rail, and most generally by carloads in bulk. The shipping of the earliest Southern crop to distant Northern cities is possible only so long as the product commands a high price in the market and ceases as soon as prices fall with the advent of the home-grown crop. The crop of the leading potato-growing sections is bought up by wholesale dealers, becoming in their hands an important article of speculative commerce. This class of merchants control not only prices paid to the producer, but in addition the shipping facilities obtainable from the railway companies, and the trade is fully equipped with the most advantageous arrangements for the safe storage and commercial handling of the great bulk of the product.

The great diversity existing in the size of American farms and in the opinions entertained on this vital point of political economy have a direct and important bearing on the amount of production in the various branches of husbandry. Wide extended possessions in tillable lands invite the culture of crops requiring the least possible amount of manual labor, conveniently superintended and directed on horseback or seated in an easy wagon. This class of farming gentlemen add no perceptible share to the potato production of the United States, for they are apt to consider potato-raising below the dignity of the owner of a large American farm. The owner of a farm proportioned to his ability to cultivate to the best advantage, expecting success from efforts in intelligent modes of culture and choice of the best paying crops, rather than relying on the breadth and numbers of the acres, is the producer of this crop. Production is therefore greater in States and sections where this class of tillers of the soil is in the majority and where general prosperity is necessarily more evenly distributed throughout the masses of the people. Referring to the statistical report, it will be seen that the average acreage of the potato crop of the years of 1880 to 1887 is estimated at 2,185,000 acres in round numbers, yielding an average annual production of 165,500,000 bushels, representing an annual value of $85,900,000. Comparing these figures with the averages of the preceding decade, it is seen that the total area of 1,500,000 acres has produced

an annual average of 133,000,000 of bushels, valued at $74,654,000, indicating a higher average of value per bushel for the decade preceding 1880, being 56 cents against 51 cents for the last seven years. The average yield per acre is estimated for 1880 to 1887 as 75 bushels against 87 bushels for the preceding decade. These estimates place the value of the crop per acre at $39 for the last seven years against $49 credited to the preceding decade. The average of production per acre here quoted can only be taken as correct on a general statistical basis, taking in the entire United States. With the producer engaged in potato culture in the district of greatest importance the average yield is much greater, ranging from 100 to 200 bushels, many localities specially favored producing even far greater crops, ranging between 200 to 400 bushels per acre. The average yield, satisfactory and remunerative to the commercial potato-grower, may be safely quoted as 150 bushels. The average value per bushel, quoted at 51 and 56 cents, applies to the market price at large, but exceeds by far the price realized by the producer, who has to divide profits (quite unevenly in general) with the shipper and transportation companies. The rebate exacted by the middlemen is comparatively light on the product raised in the vicinity of large cities, to which the crop can be hauled by the grower, but far greater in the remote northern sections, where the product can only be delivered at some convenient railway and has to be hauled over hundreds of miles to a market. Potatoes worth 50 cents and upwards in the provision trade are often bought of the grower at 15 to 25 cents, according to the distance from the market. But even at these low prices the average yield of the potato pays better than the average crop of corn or grain raised at the same distance from the market. The industrious potato-grower, willing to eat his daily bread by the sweat of his brow, using proper discretion in the selection of his location, and pursuing an intelligent system of culture, has a reasonably fair chance of success before him, and has, as a rule, more ready cash on hand than any of his landed neighbors.

PRODUCTION BY STATES.

Potatoes.

State.	Estimate.		State.	Estimate.	
	1879.	1888.		1879.	1888.
	Bushels.	*Bushels.*		*Bushels.*	*Bushels.*
Maine	8,000,000	7,308,000	Kentucky	2,268,000	3,228,000
New Hampshire	3,358,000	2,925,000	Ohio	12,719,000	13,813,000
Vermont	4,438,000	3,802,000	Michigan	10,924,000	11,885,000
Massachusetts	3,070,000	3,494,000	Indiana	6,232,000	7,491,000
Rhode Island	606,000	662,000	Illinois	10,365,000	12,188,000
Connecticut	2,584,000	2,667,000	Wisconsin	8,509,000	8,981,000
New York	33,644,000	30,431,000	Minnesota	5,184,000	6,365,000
New Jersey	3,563,000	3,328,000	Iowa	9,962,000	13,525,000
Pennsylvania	16,284,000	16,712,000	Missouri	4,189,000	6,044,000
Delaware	283,000	338,000	Kansas	2,894,000	6,046,000
Maryland	1,497,000	1,696,000	Nebraska	2,150,000	4,583,000
Virginia	2,016,000	2,246,000	California	4,550,000	4,583,000
North Carolina	722,000	1,377,000	Oregon	1,359,000	1,416,000
South Carolina	145,000	266,000	Nevada	304,000	383,000
Georgia	249,000	580,000	Colorado	383,000	815,000
Florida	20,000	155,000	Dakota	664,000	4,650,000
Alabama	335,000	590,000	Idaho	157,000	424,000
Mississippi	303,000	629,000	Montana	228,000	436,000
Louisiana	180,000	509,000	New Mexico	....	....
Texas	228,000	700,000	Utah	537,000	846,000
Arkansas	402,000	864,000	Washington	1,035,000	1,500,000
Tennessee	1,354,000	2,407,000	Wyoming	31,000	....
West Virginia	1,398,000	1,849,000			

The potato belt of the northern part of the United States can readily be traced from the above comparative list. The rapid increase of production in Southern States is to be attributed to the fast developing shipping trade in early vegetables.

The rapid settlement of Dakota Territory is likewise plainly illustrated by an increase of over four million bushels.

The Sweet Potato.—This is a plant of southern parentage, and confined for this reason to the hotter latitudes of the United States. The advantage enjoyed by the Northern States in the production of the potato is balanced by this nutritious tuber in favor of the Southern States, where it is extensively raised for culinary purposes as well as for feed of domestic stock. It succeeds, however, well in all the Middle States with perhaps a line of climatic limitation somewhere near 40 degrees of latitude, subject to many variations in different localities and in the changes of the season. The nutritious value varies in proportion to the percentage of the starch contained in the tuber. A lack of this ingredient and preponderance of gluten renders the tuber unpalatable to the taste and removes its use altogether from the menu of the household. The difference in degrees of excellence is to be attributed to conditions of the soil and to the quantity of rainfall of the season, but is owing also in a great measure to the peculiarity of the variety. The degree of maturity attained by the tuber in different sections determines the keeping quality of its vegetable tissue. The product raised in the hot climate of the cotton States can be kept over winter with far less danger of decay or dry rot than that of a more northern latitude. In the Southern States the tubers are piled in ridge-shaped heaps (banks), covered with litter and a sufficient coating of earth to keep out the frost. Further north the mode of keeping requires far more care, and must be done in temperate and well ventilated cellars. The tubers are piled into heaps with proper ventilation through the center of the pile. The pile is then sufficiently covered with straw and dry soil to exclude the air. The tubers can also be kept when bedded in wood shavings. Regarding the modes of cultivation, about the same practices are in vogue everywhere. The ground must be thoroughly pulverized by plowing, harrowing, dragging, and rolling. In the Southern States the ridges on which the plants are set out can be made with less labor than in more northern sections. Furrows 4 feet apart are opened, which are enriched by a liberal dressing of well-decomposed manure or a sprinkling of ammoniated fertilizer of cotton-seed meal. Several furrows are plowed each way on this line, forming a bed 6 to 8 inches high, in the center of which the plants are set out. Farther north the ground is ridged up by plowing and dressed up with the hoe. On the top of this ridge the plants are set. The plants are obtained by sprouting the seed tubers on a well-prepared hotbed, overlaid a few inches deep with light soil. The sprouts when 6 inches high, are pulled off and planted on the ridges prepared for them. The first crop of weeds is shaved off with the hoe, and the ground is kept loose around the plants. As growth advances a furrow is plowed off on each side of the ridge, the soil pulverized with the cultivator and plowed back to its former position, and drawn up to the plants by the hoe. As the vines increase in length they are occasionally lifted or turned to prevent their taking root. After the first frost the vines are cut off with a scythe and the tubers taken up. The planting is done in May and June, depending on the state of the weather. A liberally heated atmosphere and correspondingly warm soil is indispensable to the growth of the plant. It is customary to save the smaller tuber for seed. This indiscriminate mixture made up of the inferior product has, however, the tendency to weaken the character of the variety, causing a gradual running out of its good qualities. A careful planter will always lay the best types of tubers aside for seed for the next season. By this rational precaution varieties will improve instead deteriorating. In the Southern States the yield is very prolific; farther north the crop depends in a great measure on the caprices of the season. Three or four hundred bushels per acre is the average product attained by proper cultivation of the Southern crop. In the Middle States the average yield per acre is often considerably lower. The tubers attain quite frequently a mammoth size, weighing often 5 to 8 pounds each. One dozen

tubers making up one full bushel was exhibited by W. H. Eaves, of Williston, S. C., at the late Augusta Exposition, selected from a crop of fully 400 bushels to the acre. The average market value is 50 cents per bushel, but fluctuates in different seasons from 50 cents to $1 per bushel. The following table will show the total production by States.

Production of sweet potatoes, 1879.

[United States Census, 1880.]

	Bushels.		Bushels.
Alabama	3,448,000	Maryland	329,000
Arkansas	881,000	Mississippi	3,610,000
California	86,000	Missouri	431,000
Delaware	196,000	Nebraska	13,000
Florida	1,687,000	New Jersey	2,086,000
Georgia	4,398,000	Ohio	239,000
Illinois	249,000	Pennsylvania	184,000
Indiana	245,000	South Carolina	2,189,000
Iowa	122,000	Tennessee	2,370,000
Kansas	195,000	Texas	1,400,000
Kentucky	1,018,000	Virginia	1,900,000
Louisiana	1,318,000	West Virginia	87,000

The Onion.—A faithful companion of the potato in the garden and on the table, this spicy astringent esculent (not relished by every taste), is raised to a limited extent in almost every garden in the land. In vegetable gardening it is a leading article for the supply of the daily market, used the year round either green or in the mature state of the bulb. Being a staple article of the provision trade, it is cultivated to more or less extent by the farmer as a side crop, and readily bought or taken in exchange for necessaries of life by the rural merchant. In certain districts, especially in the northern parts of the United States, the culture of the onion is made a specialty, being there an important and remunerative agricultural crop, representing large commercial values. It requires rich and well-cultivated soil, and clean and thorough culture during the growing season. In garden culture, domestic or economical, the crop is generally started from "sets" raised the year previous from seed thickly sown in drills or produced on the stems of a variety known as the "top" or "tree" onion. In field culture the crop is started from the seed sown in drills in the early part of April or May, according to the opening of spring in different localities and different seasons. The seed is sown sufficiently thick to warrant a stand of fifteen to eighteen plants to the lineal foot. When fairly up and plainly visible the ground is stirred to destroy the first crop of germinating weeds. Hoeing and weeding by hand must be kept up until the growth is finished. The degree of atmospheric heat prevailing in the central and southern portions of the United States forbids attempts at culture of full-grown bulbs from the seed in one season. The crop is therefore raised in those sections from sets planted in the earliest part of the spring, enabling the maturing of the bulbs before the advent of the real heated term. The same climatic limitations governing potato culture apply with equal force to the onion crop. The largest production is therefore found in the Northeastern, Northern, and Northwestern States, the belt following preceptibly close on the line of the lakes and extending to the shore of the upper Mississippi. The States of Connecticut and New York, and Iowa in the West, are noted for the quantity and quality of their onion crop, from which an important revenue is derived. The town of Wethersfield in the former and Chester in the latter have earned world-wide reputations by their early and enterprising efforts in onion culture. The large, coarse, and hardy onion known as the Wethersfield Flat, raised

in the vicinity of that town for over half a century, is the parent of our later highly improved kinds, globular in form and free from the objectional scallion flavor and the thick stem (neck) of the parental stock. Careful selection of the best types of the seed onion contributed by growers over a series of years has been rewarded by the new varieties possessing the greatest commercial value. The most noticeable are the Southern Red Globe, Southport White Globe, and Danvers Yellow Globe. The White Globe is distinguished for its inviting color and mild flavor. It is, however, more tender and perishable in transit than the Red Globe, which is most extensively grown, yielding abundantly and is hardy in transportation. The Yellow Globe is principally grown in the western districts of the onion belt. The raising of seed for the trade is an important branch of the Connecticut onion industry. The seed onions are selected when the crop is gathered and are planted the ensuing spring in rich and well-prepared ground 4 inches apart in furrows 3 feet apart. Good cultivation during the growing season is required to insure a crop of well-developed seed. The seed heads are gathered about September 1 and fully cured indoors before threshing. One barrel of onions produces an average yield of 10 pounds of seed. The annual crop of the State of Connecticut is estimated, in the absence of any official statistical figures, at 1,000,000 bushels. Its principal market is the port of New York, to which the greatest percentage of the crop is shipped in vessels. The average ruling price realized by the grower is $2.25 per barrel, varying, however, in different seasons. Prices paid for the product in most of the inland districts, depending solely on railway transportation, are materially lower, ranging between $1 to $2 per barrel in different seasons. The Western crop of Illinois, Wisconsin, and Iowa, and from the farther Northwest, drifts principally to the commercial centers, Chicago and St. Louis, and westward to the mining regions. The great extent of this industry in the Northwest is, in a measure, due to the advantage in freight rates offered by the navigation on the Mississippi River, by which enormous quantities are landed annually in the port of New Orleans, from whence the product is largely shipped to South American ports. The crop of Colorado, Utah, and the Pacific States is worthy of special mention in this connection, not for the numerical magnitude, of which no statistical figures are obtainable, but for the monstrous size of individual specimens raised in the pure mountain air under the extensive system of irrigation. Large shipments of onions of a mammoth size are made to the cities of the Atlantic coast, where they are sold under the name of Spanish or Mexican onions.

Turnips.—Turnips are generally cultivated for fall and winter supply of the table and for stock-feeding. The comparatively light demand of the wholesale provision trade is supplied with the best flavored and the most tender sorts, such as Purple Top, Flat Dutch, and other valuable kinds, of which there is a large variety offered by the seed trade. These are sown broadcast in July and August. The richer the ground the more sweet and crisp and the larger the size of the product. The Rutabaga is the most important commercial variety of this family, possessing a rich flavor and great firmness of texture, which, in addition to its large size, makes it a popular offering in the produce and shipping trade. Its proper latitude is in the northern and northwestern sections, where it is raised to a great extent, both for the demand of the large cities and for winter feed for stock. It is sown in the early part of summer on ridges formed with the plow, and thinned out to a distance of 9 inches in the row. It is cultivated like other summer crops by hoe and cultivator. Rich new soil will produce a satisfactory crop without the application of manure or other fertilizers. When raised on older land or thin and stony soil, so generally prevailing in the New England States, where the crop is largely cultivated, a liberal dressing of fertilizer is indispensable to secure an average paying yield. The rows are here laid off in furrows in which the fertilizer is placed, on which two or three furrows are turned from both sides, this forming the bed on which the seed is sown.

Carrots and Beets.—Are handled to some extent in the provision trade as table vegetables for winter use. The most prominent kind are the Long Orange Carrot and Long Blood Beet. The earlier varieties of both kinds are extensively grown by the market gardener and in the family kitchen-garden. The large size beets, grown so extensively for stock-feeding in Europe, are cultivated in the New England States, and to some extent in the Northwestern States and Territories. Climatic conditions and the limited area of farms and corresponding limited feed supplies to last over long winters necessitate a system of agriculture in the Eastern States resembling more closely that of densely populated European countries, but varying from the modes of farming in vogue in the Central and Western States, where the production of grain and corn and hay is so abundant as to induce a reckless waste of much valuable material, which would be highly esteemed and made use of in sections favored in a less degree by nature. The root crops, so highly esteemed in stock-feeding and in the dairy industry, have for this reason been more or less neglected, especially as their culture requires a large outlay of labor. Rutabaga turnips, carrots, and mangel wurtzel (the imported name of the stock) are nevertheless largely cultivated in sections of the West and Northwest, and will grow steadily in favor in the ratio in which our present primary modes of husbandry are replaced by more intelligent and intensive systems of farming. The sugar beet has been grown in large quantities, both for stock and feeding, for which it is highly esteemed, and for experiments and tests in sugar manufacture. Being the only sugar-producing plant succeeding in the cool climate of the European continent, it has attracted wide attention in this country, and has enjoyed the special care and investigation of the Department of Agriculture. The economic and commercial value as a sugar plant remains, however, still an undecided question, the final solution of which must more or less depend on government politics fixing the value of the sugar product of the United States. The sugar beet, like its near relative, the mangel, is only suitable to the moderate temperature of the northern belt of the territory of the country.

Sugar Corn.—Though a cereal product and therefore outside the scope of these pages, its mention in this connection may nevertheless be admissible, as it is a leading culinary vegetable in the daily markets in its season, and an important material of the canning industry. It is in consequence a great field crop planted at different intervals to insure a constant supply of tender, milky corn throughout the season. There are many varieties of great merit, differing in earliness and size of the ear. All sugar corn varieties are, however, distinct in sweetness and flavor from the general kinds of field corn.

Pumpkins.—Frequently an additional crop in the field, these are largely grown for stock-feeding, and are, to some extent, used for culinary purposes. Outside the "Connecticut field"—the most popular kind grown in the cornfield, there are various kinds distinguished for either size or flavor of the edible tissue, which are grown to some extent.

The Artichoke.—A species of the genus Helianthus, is a prolific producer of a crop of tubers under the surface of the ground, relished by some tastes, but mostly used as a valuable feed for stock, especially swine. It is grown in many places in small fields or patches, to which the swine are admitted to the gathering of the crop in their own peculiar way. A patch of winter pasture of this kind will last for many years in succession, as enough tubers are left in the ground to insure a crop for each ensuing season.

MARKET GARDENING NORTH.

Market gardening, as carried on in the vicinity of every large American city, is practically the same in methods as pursued in Europe, and may justly be called an extension of long known horticultural practices from across the ocean readapted

to the peculiarities of soil and climate of this continent. Its earliest pioneers in the eastern cities had seen service in English and continental gardens before landing here, and the rank and file of operatives employed at present in the industry are in greater part of foreign nativity. The profession, if such it can be called, is a laborious and painstaking calling, requiring a peculiarly industrious and willing class of workers. These typical traits are fully represented in the American branch of the fraternity. The genuine market gardener of New York or Boston is the same in sentiment and in freedom from fatigue or fear of constant labor as the *maraîcher* of Paris or the London gardener. The uneven chances of competition with this proverbially industrious class of labor prevents, undoubtedly, many from engaging in the industry, who would otherwise be attracted by the profits arising from the trade. In rural districts, noted for enterprise in vegetable culture, all classes, irrespective of nationality, are represented. One branch of the industry is strictly horticultural in character. This is the forced culture of every table luxury and of plants for setting out in the open ground, requiring the skillful handling of hotbeds and plant houses. The other is agricultural in tendency, being the cultivation of the crops in the field and garden. A union of the two makes up the commercial vegetable garden, devoted to either of these specialties in culture. The larger establishments for forced culture, operating extensive areas under glass, cultivate as a rule only a limited breadth of garden land, on which the most skillful rotation of the best paying crops is followed the year round. All gardens devoted to outdoor culture, however, have a plant of hotbeds to provide plants required for the earliest crop. Conducted on an extensive scale at greater distance from large cities the business assumes the character of general field culture. The conventional terms of market gardening and truck farmer are therefore well chosen, expressing the difference existing between the two wings of the profession.

As a succulent, crisp, and tender tissue is an essential characteristic of culinary vegetables, they can be produced only by vigorous and rapid growth. A soil sufficiently rich and suitable otherwise is necessarily of foremost importance, and constant culture of the growing crops is not less indispensable to success. The entire routine of work performed by the market gardener tends directly to the attainment of these ends. The location of the garden is chosen with due regard to adaptability of the soil and to a sunny exposure, the ground is plentifully manured, the hoe and cultivator are kept in lively motion, and facilities for irrigation are provided for as far as possible. The supply of manure is the controlling factor in the outfit of the garden. Convenient distance from the base of supply, the cities, or facilities of cheap transportation to greater distances are, therefore, important requisites of a suitable location. In the near vicinity of the cities the manure is hauled by wagon; to more distant parts it is shipped in vessels or by rail. Could tonnage of crafts, cars, and vehicles employed in this traffic be correctly computed a sum of almost incredible amount would be presented.

Demand existing for commodities and prices paid for them control the trade in perishable vegetables in a more marked degree than markets of more staple goods. Abundance of supply will invariably depress prices; comparative scarcity, on the other hand, will maintain them on a higher scale. The efforts of the market gardener conform strictly to this universal regulation of all values. The earlier his product, the higher will be his price; the later, the more they will suffer the depression of the market. Hotbed culture is for this obvious reason the most profitable branch of market gardening. In outdoor culture every possible effort to promote the earliest growth and maturity is made, and the financial success of the season depends materially on the time in which the leading crop can be brought to the market. No wonder, then, that the Northern grower is frequently alarmed at the extent to which the shipping trade in Southern-grown products, so rapidly increasing from year to year, affects the markets. Home-grown products being

fresher and more inviting than those shipped from a long distance, are naturally preferred and command a quicker sale; but as the quantity of far-fetched supplies in the market has already depressed prices, the home grower loses the advantages enjoyed in former years by the earliest products of the season. It must be obvious that the influx of Southern products into Northern markets has already curtailed the possibility of unlimited expansion of the home industry which the rapid increase of population would naturally invite. The advantages offered by the most favored sections of the Southern States attract both capital and skilled labor, which would otherwise seek a field of action in the vicinity of the great cities of the North.

The effects of this south-bound tidal wave are plainly visible outside of general observations by the fact that many parcels of ground convenient to the New York markets, which formally commanded a high rental and eager takers, cannot be rented for gardening purposes any longer, and are neglected in consequence back to ordinary agricultural uses. A similar falling off in new enterprise in this industry is felt in the surroundings of other leading cities, while Southern horticultural development makes rapid and astonishing advances. But fortunately not all delicacies of the table, so generally craved with the coming of spring, can be successfully shipped over the great distances, and such products are comparatively unaffected by Southern competition. For illustration, radishes and lettuce, so largely used by so many families, may be mentioned. They are in consequence the leading crop raised under glass and will continue to be raised in close proximity to the daily markets. The forced culture of cucumbers and early melons, on the other hand, is in a great measure superseded by Southern products. Many home-grown products which formerly commanded high prices at their first appearance in the market are now a succession only to the Southern crop, losing in consequence the benefit of higher prices heretofore commanded by the first. Uninterrupted supply of fresh and tender vegetable products is a noted peculiarity of the daily provision markets. The efforts of the producer tend primarily to the attainment of this end, by which correspondingly continuous receipts are secured. Fast-growing spring crops of herbaceous truck, used only in the tenderest state, must therefore be reproduced from time to time by a new crop, necessitating a skillful successive sowing of a new supply at well-chosen intervals between each other.

Perennial vegetables, as asparagus and rhubarb, are doubly valuable owing to the ease of their culture when fairly established in the soil and the certainity of their yearly yields, almost unaided by labor. An additional advantage is the facility with which they can be forced and made to develop stems and leaves long before climatic conditions would otherwise admit.

Asparagus, a leading staple of the vegetable trade of spring and early summer, is grown in immense quantities, impossible to be estimated by exact figures. All commercial gardens have their patch of more or less extent. It is largely grown also as a speciality in favorable localities, particularly on lands in close proximity to the seashore. In garden culture it is grown in beds especially prepared and heavily manured. In field culture it is lined out in rows 3 or 4 feet apart. One or two year old roots are chosen in the planting of a new patch or field. Salt and nitrate of soda are powerful stimulants to its growth, and are largely employed in its culture. It requires annual and liberal dressings of manure applied in fall or winter. The shoots are used in the green or bleached state, and are cut in the latter case when 6 inches above ground. When desired white they are cut when appearing on the surface of the ground. When tightly done up in bunches, and well packed, the product bears transportation to great distances, and it is in consequence a welcome article in the shipping trade. The most popular variety in the trade is "Conover's colossal."

Rhubarb is used for the succulent and tart tissue of the leaf-stalk. It is raised

from seeds or by dividing old stools. Deep and rich soil and an abundance of manure for a mulch is all that is required to produce stalks of large dimensions. Its limited use in cookery necessitates a limited extent of culture likewise. Large quantities, however, are sold in the early part of the season, especially before the advent of small fruits. The most popular varieties are "Linnæus," generally grown by market gardeners, and "Victoria," producing the largest and longest stalks. "Paragon" is the best flavored variety.

VEGETABLE FRUITS.

The Tomato is a typical American vegetable—raised and consumed universally throughout the United States. It requires degrees of heat peculiar to the American summer to ripen the fruit in rapid succession. It is one of the leading articles in the shipping trade, and is extensively grown for canning. The plants are raised in hotbeds and removed to the open ground when the temperature of air and soil is sufficiently heated to warrant their rapid development. It succeeds in most all soils and localities. The earlier crops, however, are planted on ground of moderate fertility to prevent an undue or rampant growth, by which the early setting of a full crop is materially retarded. The commercial grower devotes much attention to raising stocky, well-rooted plants, which will bear transplanting without an undue check to their growth. The plants are frequently raised in pots or transplanted several times while growing in the hotbed. They are set in rows at an average distance 4 to 5 feet each way. When fairly established in the field the ground is carefully worked by cultivation to advance their growth; when the first crop of fruit is set and swelled to fair size, cultivation is slackened off in order to check the rampant growth of the vines and to induce earlier ripening of the fruit. The earliest planting is always followed by a later one, from which the fall crop is obtained. The yield is, as a rule, very large, varying from 200 to 400 bushels to the acre. For shipping, the fruit is packed before full maturity, according to distance of destination and time required for transportation and marketing when arrived. The immense shipments coming to the markets of the larger cities affect materially the price of the home-grown product, which, however, becomes sufficiently abundant, when once in season, as to drive the southern product out of the market. The quality of the fruit has of late years been wonderfully improved, and has attained a standard of perfection which seems difficult of further improvement. A mention of all the good varieties cultivated would give a list too unwieldly for these pages. The most noteworthy are "Acme," "Trophy," "Paragon," "Mikado," "New Queen," and the Livingston seedlings, "Beauty," "Perfection," and "Favorite."

Egg Plant is botanically related to the tomato, and requires a high degree of temperature to attain perfection. It requires a rich soil and sunny situation. The plants are started and grown to good size in the hotbed and transplanted when the heat of early summer has set in. The dark purple kind attains a large size, 6 to 8 inches in diameter, in favorable seasons. It is highly prized with many; extent of culture is, however, limited.

Melons grow freely in all sections of the United States in which the mean of temperature required for their maturity prevails. The Southern and Middle States are in consequence most suitable to their extensive culture, and this territory supplies the Northern markets nearly altogether as in the northern section the home crop is late and frequently inferior in quality. The plants there must be raised under glass and be transplanted with the advent of summer, while in the Southern and Central States the seed is sown in the open ground. They require a rich and loose soil, extending their long, feeding roots over a breadth of ground. The plants are set to a distance of 5 to 6 feet each way and require judicious culture during their growing season.

The Watermelon is one of the most popular relishes of the American people used freely by all classes. The supply is most abundant in all cities of the country, thanks to the immense shipping trade in that product. It is grown extensively along the Atlantic coast, principally south of New York, the crop requiring a large fleet of coasting vessels of all sizes, which lend a peculiar air of animation to the leading ports. In the interior the product is transported by rail and is a leading article in the fruit traffic in its season. North of the Ohio River it is raised in many favorable localities, mostly in rich, alluvial, and sandy soils. Farther north the crop is more uncertain and ceases to be made a commercial venture.

Muskmelons and Cantaloupes are raised to less extent than the watermelon, but are highly valued by many as a luxury, being therefore abundant in the markets. They can be successfully raised in a more northern degree of latitude than the watermelon. The cantaloupe is largely grown in the Middle States, and is shipped packed in crates or well ventilated barrels to the markets. They are, withal, a favorite crop with a majority of the market gardeners of the leading cities, as the fresh, normally ripened, home-grown product is much preferred to fruit necessarily picked before maturity.

The Cucumber succeeds well in all parts of the United States, and is extensively grown as a commercial article for the early and later markets of the season. The earliest supply is obtained both by hotbed and out-of-door culture outside the supply received from the southern fields. The later crop is valuable for pickling purposes and for the supply of this extensive industry a corresponding acreage is annually planted in sections near the leading establishments devoted to this branch of trade. Rich soil and a sunny exposure are necessary for the earliest crop; the later crop can be raised on any good, tillable land. It is planted in midsummer generally as a succession to other crops. The improved "White Spine" is the most popular variety with gardeners.

The Squash.—The great variety of kinds differing in form, color, and the texture of the edible tissue may be classed as squashes for winter and for summer use, and as kinds grown principally for variety or curiosity sake. The "White Bush squash," with scalloped margin is the kind principally raised for early summer use. Varieties named "Hubbard," "Essex Hybrid," "Marblehead," etc., are of larger size than the foregoing, and are used in winter. All other odd-shaped kinds, as Crook-necks," "Turban-shaped," and of other forms are edible likewise, but more ornamental than useful.

Peas.—The pea crop of early spring and summer represents a large commercial value and is a large product of the garden. It is extensively grown everywhere, and, being a leading article in the canning industry, production runs into immense figures as to number of bushels raised annually. The plant is very hardy, and in consequence its seeds are among the first sown with the coming of spring. It is cultivated generally in double rows, one foot apart, in which space the brush for upholding the vines is stuck, a space of three feet being left alternately for cultivation and picking. The dwarf varieties can be grown in any way convenient for the picking of the pods; good culture advances growth and earliness of the product. The plant is planted in different successions a fortnight apart. The earliest varieties in general reputation is "Cleveland's Alaska," "Philadelphia Extra Early," "Improved Tom Thumb," and many other good varieties offered in the seed trade are grown for the earliest crop. A later crop is made up of the Marrow Fats, Blue Imperial, and other varieties. The pea bears shipping to a distant market, provided heating and bleaching of the pods can be prevented. It cannot be shipped in large bulk, and suitable packages must be well ventilated.

Beans.—Few culinary vegetables yield an equally large supply of solid food as that derived from this family. Outside of its use as a grain it is widely used in the daily menu of the summer season, lasting until the plant is nipped off by frost. A

majority of kinds are used as tender pods; of others the tender seed grains, partially matured, are used. The pods of some varieties are green, those of others waxy yellow. By this distinction the kinds are known as string beans and wax beans. Varieties are distinct likewise as to the manner of growth; some grow bushy and low, others are climbers, requiring a support; they are classed as bush and pole beans. The "Improved Red Valentine" and "Best-of-All" deserve special notice among the many kinds of green-podded bush beans. The French Flageolet family embraces various kinds of the best sorts of the dwarf wax bean, and is preferred to the oldest kinds. Among pole beans the "Dutch Case Knife" stands first for green pods. Several varieties of running wax beans are extensively cultivated and of considerable value. Horticultural Cranberry Bean is an old reliable runner and highly prized. The Lima beans are, however, the most widely cultivated. A bush Lima bean has lately been introduced by Peter Henderson, of New York, which gives promise to be of more than ordinary value. The culture of the bean is generally understood. A warm, rich soil is needed for the earliest kinds; the pole beans may be raised in ordinary garden or field soil. They are largely planted among the corn, which serves the purpose of support or poles. The Limas are generally planted in rich and deep soil, and bear abundant crops until cut off by frost. The shelled beans when dried in their tender state make a palatable substitute for the green in winter.

Okra—Gumbo is raised to some extent in all market gardens. The green pods contain a large percentage of mucilage, and are used for seasoning and enriching soups. It demands a high temperature to insure full development. It is raised in the Southern and Middle States as readily as corn, but requires more care at the North, where it is often started in the hotbed and transplanted to a warm and sheltered position. The green pods are largely dried for winter use.

Pepper.—This fruit is mostly grown for pickling and seasoning purposes. The large Bullnose pepper is the most noted variety for pickling. The Cayenne varieties bear a profusion of long and showy bright-colored seed pods, much esteemed for sharpness of their peppery contents, known as Cayenne pepper. The plants are started in the hotbed and transplanted outdoors. Further south the seed can be sown in the open ground.

ROOTS.

The Beet.—The early turnip beets grown by market gardeners are a leading spring crop and highly esteemed in the daily markets. They are sown in warm and sheltered positions or transplanted from the frames in which they are largely grown for the planting out in the open ground. The richer the soil the more rapid is their growth. They are planted in rows sufficiently far apart to admit of good culture. Egyptian turnip and Early Blood turnip beets are the most noted kinds grown by the trade. For fall and winter use the Long Blood beet is the standard.

Carrots are classed according to their shape as turnip-shaped, half-long, and long. The small "turnip-shaped" is grown mostly in the forcing beds. The "half-long" kinds are the leading summer varieties. The "long" rooted kind is mostly grown for winter. Rich soil, early sowing, and good culture is again the rule for the best success. Demand is more limited than for the early beets; they are grown, therefore, to a limited extent.

Radishes.—A limited variety is grown by the professional gardener acquainted with the value of the best in the market. Scarlet Turnip and Long Scarlet are the earliest, grown under glass or in the open ground. They are followed by turnip-shaped and half-long white or yellow sorts, which yield the greater part of the early supply. Late winter kinds of different varieties are grown to some extent, of which the Chinese Rose is the strongest if not the tenderest also. They are mostly sown broadcast at different intervals during the season. In abundance of manure lies the main secret of greatest success.

Turnips are raised to some extent for an early spring supply, demand for which is, however, light at the time when all summer vegetables most abound. The later crop generally raised in the field culture has been alluded to in the foregoing,

The Parsnip is a nutritious root of peculiar flavor, largely raised for winter use; it is perfectly hardy in the coldest winter, but is dug in the fall for a supply while the ground is frozen. The spring supply is taken from the ground as demanded. There is but one variety, but much defective seed, producing irregular shaped and forked roots.

Salsify, or Vegetable Oyster, is a root extensively raised for winter use. It is sown in spring, in well-manured ground. Requires good culture and genuine seed, not always easily obtained.

LEAF VEGETABLES.

The Cabbage.—The universal use made of the leaves, folded tightly into a solid mass which we call a head, an article of daily food, makes this family one of the most important among culinary vegetables; production is, in consequence, greater than in any species outside the potato. The family is a staple product of the commercial garden, and a large area of the most fertile land found in the country is devoted annually to its culture. The quantity of tender vegetable tissue necessary to the formation of the head requires a corresponding abundance of plant food in the soil, which can only be secured by liberal application of manure.

The plants for the early crops are raised in the hotbed and in cold frames, and set out early in spring as soon as the frost of winter has spent its force. The plants, if properly raised and hardened before transplanting, are not sensitive to light frost. Constant culture of the growing crop is indispensable to a paying yield. The great variety of kinds is classed as to earliness or fitness for the later supply of fall or winter. The early kinds are cone-shaped in form, as the York, Winnigstadt, Ox-heart, and Jersey Wakefield. The later sorts form large round heads, and are known as Drumhead, Flat Dutch, Brunswick, etc. A valuable intermediate variety between the early and the late kinds is Henderson's Early Summer, related in form and habit to the Flat Dutch varieties. The curled varieties, possessing a peculiar flavor, are known as Savoy cabbage. There are several varieties of red-leaved cabbage, used principally for salad and pickling. The markets are supplied first by the earlv southern and later on by the local crop, generally equal to all home demands.

Immense crops are raised in many localities along the Atlantic coast, from whence the crop can be shipped in vessels to the seaport cities. Districts in which cabbage culture is a specialty are so numerous throughout the Middle and Northern States that names can not here be specially mentioned. The vicinity of the great Northwestern metropolis, Chicago, is worthy of special notice in this connection. Besides the advantage of a lake shore climate and a soil of great productiveness, this region is within easy reach of the greatest supply of manure found anywhere on the continent, owing to the fact that Chicago is the commercial centre of live-stock trade of the Northwest, provided with the greatest stockyard accommodations, and is at the same time the centre of the slaughtering and packing industry of America. The daily output of manure is so enormous that it must be removed on railway cars, on which it is run out in the vicinity, sometimes to great distances, and sold cheaply to agriculturists and gardeners. The cabbage production of this section has thus become a leading agricultural feature, and is the basis of a large shipping trade to points south of Lake Michigan.

Cauliflower.—The culture of this vegetable is not of such wide extent as that of the cabbage, and is confined mostly to the leading market gardens. Some districts in close vicinity to the seashore and the lakes have proven specially suited to this culture, and make it a highly remunerative specialty. The New York market is

in this wise supplied principally by the cauliflower fields of the eastern shores of Long Island, and a large percentage of the Western demand is supplied from the lake shores of the north. In the gardens of the Middle States the early spring crop only can be depended upon with reasonable certainty amidst the varying chances of the seasons. Late crops are seldom planted. The plants are raised under glass and the earliest crop is produced in frames. The seed is imported from France and Germany.

Kohl Rabi, or turnip-rooted cabbage, is a cabbage producing an over-ground turnip. It is raised to a limited extent in many market gardens especially for early spring supply, as the tissue is most palatable in its tenderest state. When full grown it is astringent, but valuable food for stock.

Brussels Sprouts is a tall-growing cabbage stalk, the stem of which produces a profusion of small miniature heads of cabbage of high flavor. The plant is little grown, being subject in many seasons to the attacks of the cabbage vermin.

Kale, Borecole, Greens, a species of the cabbage family, grown extensively for greens. The dwarf varieties are sown broadcast in the fall; being extremely hardy, they can be used during the winter and early spring. A spring crop, sown likewise for early summer use, is known as cabbage greens. The tall variety is planted out in rows and is hardy during winter.

Collard, a rampant-growing, large-leaved cabbage, species nearly related to the kales; is grown extensively in the Southern States, mostly for stock,

Spinach is widely planted for greens for fall and early spring. It is a very popular article in the daily markets. The Bloomsdale or Savoy leaved is the most valuable variety.

Celery, one of the most popular table luxuries, requiring a cool atmosphere and a damp, rich soil. Its extensive culture during summer is, therefore, necessarily confined to northern sections and to a peculiarly suited spongy soil. It is grown, however, extensively throughout the Middle States in the latter part of the season, and yields paying crops if irrigated in time of drought. The vicinity of the city of Kalamazoo, Michigan, situated midway on the peninsula between Lake Huron and Lake Michigan, has attained great notoriety for the extent of celery culture. A dismal swamp, formerly unfit for any agricultural purpose and shunned even by the birds of the air, has proved, after being drained, to be the most suitable land of the entire country for the production of this crop. An area of 1,500 acres is now one continuous celery field, owned and operated by perhaps one hundred different growers, employing fully 1,800 laborers. This industry has increased within the last eight years with wonderful rapidity, finding a ready sale for the product in every city of the country, and for six months of the year, July to January, it fairly crowds the markets. The whole area averages two crops, the first coming in July and August and successive ones coming from September to December. In the best localities three crops can be raised in one season, so rich and appropriate is the land for the purpose. The annual output of this section is estimated by the express companies handling the greater part of its transportation at 7,200 tons, equal to 720 carloads at 20,000 pounds to each. Seventy-five per cent of the crop is shipped by express, the balance in bulk by refrigerator cars. Prior to the inception of this immense trade of the above town the vicinity Chicago had the lead in the celery trade and is still largely engaged in the business. In other sections of the Northwest the industry is fast taking a foothold, and competition will be sharp in the near future. The varieties "White Plume" and "Golden Heart" are the most generally cultivated about Kalamazoo, being easiest grown and requiring the least labor in bleaching. The culture of turnip-rooted celery (Celeriac) is quite extensive in some of the Eastern States and the lake regions, and commands paying prices. Plate XXXII and XXXIII will give an idea of the nature and extent of the celery farms of Michigan.

CELERY-FIELD SCENE, KALAMAZOO, MICHIGAN

CELERY GARDENS AND WAREHOUSE OF DUNKLEY & SON, KALAMAZOO, MICHIGAN.

Leek and Garlic, two members of the onion family deserving of mention as minor crops, are raised in moderate quantity by the market gardeners.

SALAD PLANTS.

Lettuce is very extensively raised everywhere and a leading staple article of the early spring season with the market gardeners. The earliest supply of the winter months is produced in hotbeds and cold frames. The extreme hardiness of the winter plant permits the earliest sowing of the season. It is, in connection with tender radishes, the season's first product from the garden. The valuable sorts, forming large, solid heads, are grown with especial care and in great quantities, the supply lasting until the hottest weather suspends its growth. It makes its welcome appearance, however, at an early day in fall, and is offered for sale throughout the winter.

Endive, a salad for fall and winter use, is largely grown in the vicinity of the larger cities. When the plant is well developed the leaves are lightly tied up to cause the bleaching of the interior and succulent portion.

Corn Salad—Fetticus—a small, thick-leaved plant, is an article frequently met with in the market from fall to spring, used as a salad only.

Chicory, Barbe de Capuzin of the French, is not as popular a salad relish as in France, but grown to some extent, nevertheless. The plants are grown from seed sown in the open ground; the roots are taken up before winter, tied in bundles, and heeled-in in a dark place in the cellar or the greenhouse. The new growth of the tender, bleached leaves is used for salad. Absolute darkness is indispensable to a tender and palatable article.

Cress or Pepper Grass, a hardy annual plant, is sown in early spring, and comes into use in a few weeks.

Water Cress is grown in a rich, swampy land, which can be set under water at the option of the grower. In suitable localities it is a well-paying crop.

Mustard.—The white species and improved varieties are grown considerably for greens and salad. The tender leaves of turnips grown in darkness are also much used as winter salad.

SEASONING HERBS.

Parsley and *Chervil* are most usually grown, the former very largely. A variety of other herbs, annuals or perennials, are cultivated as a necessary appendix to the list of culinary vegetables.

MARKET GARDENING IN THE SOUTH.

The development of vegetable culture on a commercial scale in the cotton States is of comparatively recent date. As the labor indispensable to this pursuit could not be obtained under the conditions of the social fabric prior to the civil war, the industry remained confined to the supply of the large Southern cities, and exchange of the minor products of the garden with the North was not seriously thought of outside the commercial staples and necessaries of the general trade. The rapid rise of this industry has already wrought many changes advantageous to the sections directly affected, by which the value of realties has been materially advanced and multitudes of otherwise idle laborers find profitable employment. Its value from the standpoint of political economy is, in consequence, conceded on all sides. The modes of culture are practically the same as those pursued in the Middle and Eastern States, with a wide margin of advantage in favor of the Southern genial climate, in which no costly plant for forced culture is required. The disadvantages, however, are the distance from the markets and all the vicissitudes of transporta-

tion, the overcrowding conditions of the market at certain times, in which products go frequently for the bare cost of transportation. These drawbacks are in great measure beyond the control of the Southern grower. Wise foresight in the choice of crops and care in preparation and packing of this perishable merchandise can, however, obviate to some extent the results so frequently unsatisfactory to the shipper. Climatic conditions of the season have great influence on the quality or firmness of the products, excesses of rain rendering them too soft and perishable for the long transit to the market. The market is quite frequently demoralized and depressed by large shipments of unsound and worthless truck which a cautious shipper would not have sent out. This is a standing evil complained of by the commission merchants at the North and reliable shippers alike. More losses occur from the quality of the product and carelessness of the packing than by the occasional gluts of the market. The most southern points have necessarily the great advantage of earliness of their products. The greater distance and higher freight rates are fully balanced by the absence of the competition in supply. More northern points suffer oftener by overcrowded markets and corresponding decline in prices. Competition, or, rather, its inevitable consequences, regulates, therefore, the choice of locality and selection of the safest crops.

The first ventures in this industry were made in the vicinity of Norfolk, Virginia. From there it spread rapidly along the Atlantic coast until the most southern points in Florida were reached. Thus each locality had to accommodate its plan of production to the steadily changing demand and chances of competition.

The South Atlantic seashore, having unlimited steam-navigation facilities to the great seaport cities of the East, enjoys necessarily the lion's share of the advantage in transportation as well as in the best markets. The products of the shores of the Gulf must seek their market in the great inland centers of the Middle and Northern States, and depend solely on railroad transportation; their margin of profit must, therefore, be guarded more jealously than that of the Eastern trade. The industry is thus, portioned off by geographical lines of longitude. These are, however, diagonally traversed for a time by the earliest products of the Bermuda Islands and of Florida, shipped to the Western and Northwestern markets.

The Southern vegetable fields are necessarily located in close proximity to the shipping ports of the Atlantic coast and along the leading railway lines connecting the Gulf States with the West. Breaking boldly into the long-established lines of exclusiveness in agricultural products, this new industry will be of more than passing importance in the future development of the resources of the Southern States.

The leading articles best suited for shipment over long distances are the potato, onion, tomato, melon, cucumber, bean, peas, and cabbage. Most of the other vegetables are furnished almost as soon as wanted by the local gardeners of the vicinity of each important city, and being more perishable than the above-named staples, their shipment to distant markets is necessarily more risky and unprofitable.

The Bermuda Island products, consisting of onions, potatoes, and tomatoes, are the first in the markets. Coming in the cold weather of January and February, they last from four to eight weeks unimpaired by decay. The tomatoes are smaller than those raised in the States, but being the only supply obtainable they are a profitable crop to the Bermuda grower, yielding a return of $400 to $500 per acre. Florida is, however, only a few weeks behind the Bermudas, and is soon followed by Georgia and South and North Carolina products, which go by the cheap water routes principally to the eastern cities.

New Orleans is the earliest base of supply for the western markets, and south Alabama, Mississippi, and Texas follow in quick succession. This may be called the southern belt, between which and the regular markets there is a vast intermediate territory, in which truck-raising is carried on to a wide extent. The ship-

ments of this section fill the markets to their fullest capacity and supersede the products from the southernmost points. The vicinity of Norfolk may be regarded as the most important half-way station between North and South. The loss of its former prestige as the earliest point is fully made up by the advantage of a greater choice in products which could not profitably be shipped from more southern points. Many southwestern districts in Tennessee, Kentucky, and Arkansas occupy a similar position in the shipping trade.

Potatoes.—The earliest potatoes coming from Bermuda are principally Chili Red, and appear in the market in early March, packed in 3-peck boxes, selling at $2 to $3 per box. The kinds principally favored in the States are Early Rose, Early Ohio, Early Sunrise, Beauty of Hebron, and Burbank. The principal part of the southern crop comes in the beginning of May, the supply of last year's crop being by that time more or less exhausted or discarded by consumers; $4 to $5 per barrel is the ruling price. In early June, with the gradual appearance of the home-grown crop, prices decline to $2.50 and $3 per barrel, or $1 per bushel. The product is shipped in well-ventilated barrels, and the condition in which they are received has great influence on prices realized.

Sweet potatoes are shipped largely to northern markets. The new crop appears in the latter part of July, being frequently disfigured in appearance by rough handling and generally of large and unwieldy size. The crop product of the Middle States, mostly Nansemonds, is preferred and commands higher prices. Average price 1st of August is $3.50 per barrel for shipment and $2 per bushel for Nansemonds. In September the average price of shipment was $2.25 to $2 and $4 per barrel for Nansemonds. Later on southern yams are $1.75 per barrel, with $3 for Nansemonds. Prices of this product are fluctuating, and no general average will apply correctly to different seasons.

Onions.—The first shipments come as stated from the Bermuda Island and Florida lasting to the beginning of June. The early southern crop is then received. The ripest bulbs are selected in the field at different intervals, pulled, and when dry packed in bushel crates which sell from $1 to $2.50 per crate. The vicinity of Norfolk is specially noted for its extensive onion output, mostly grown from sets of the potato onion, planted in the previous fall. In the southwestern States this crop is likewise extensively cultivated.

Cabbage is found in the market throughout the year, the old and new crop appearing side by side and prices are governed by the old stock in market. It is shipped in barrels and crates, requiring much ventilation and tight packing. The skrinkage by decay of the outer leaves is very great. The earliest shipments come 1st of April, commanding often $5 per crate. As quantities increase the prices drop to $3.50 to $4 per crate. In western markets the California crop has come into competition with the shipments from Mobile and Louisiana and bids fair to materially reduce the acreage to be grown hereafter in the southwest. California shipments come in bulk carloads and are sold at retail at 3 to 4 cents per pound. One hundred and seventy-five barrels, or crates holding same quantity, are considered as good average crops per acre.

Cauliflower.—The culture of this valuable product is greatly restricted by the difficulty attending its safe transportation to distant markets. Its delicate white tint is frequently turned yellow by heating or bruising. The earliest shipments from Florida coming in March are less liable to heating in transit. Prices rule always high, as the market is never overstocked. The seashore of the South could produce abundance and to spare were it not for the difficulty of safe transit.

The Cucumber is one of the best shipping articles of the shipping trade. The earliest shipments appear in February from Florida and New Orleans, commanding $2.50 per dozen; as receipts increase the prices rule from $1.50 to 50 cents per dozen and go generally lower as the season advances. The home crop of eastern

and central cities, raised to some extent in frames, appears in quantity in May and being so much fresher and presentable, drives the southern product from the market.

Green peas appear usually in February and early March, from southernmost points, the first bringing $3 per box holding 3 pecks. In March, becoming more plentiful, prices drop to $1.50 per box. During April the general crop of the Southern States appears with prices ranging from $2.50 to $1.25 for bushel boxes which is somewhat higher in proportion, being generally in better order. The green pea is a profitable crop for southern growers but must be packed in well-ventilated boxes. When wilted and bleached, their market value is materially reduced.

String beans.—Earliest arrivals appear in latter part of March from Florida and New Orleans, selling at $3 to $3.50 per 3-peck box. About the middle of April they are more plentiful and range from $1.50 to $2 per box but with increasing supply they drop to $1 to $1.25 per box. In the early part of June the local crop begins to arrive and southern shipments gradually cease. This product requires great care in packing and loss in most all instances is the result of improper handling and shipping. The wax beans command as a rule the highest prices.

Tomato.—The results of competition in the different sections of the South are clearly illustrated by this leading product. The earliest crop used to come from the vicinity of Norfolk, Va. Later, that from the vicinity of Savannah, Ga., led the market, realizing frequently $8 to $10 per bushel in Eastern markets. At present $4 is all that can be expected, as Florida, earlier still, ships very largely to the Eastern markets. Production north of Florida is in consequence limited in accordance with the output of that State. Shipments to the West have therefore been quite limited, but will increase in the ratio of the reduction of transportation rates inaugurated by the railway companies. Southern Alabama, Mississippi, Texas, and Louisiana, are the main basis of Western supply. A leading vegetable-growing center of Mississippi, Crystal Springs, is specially known as a successful tomato-producing center, the products of which find ready sale in the Western markets at better rates than obtained by other sections during the month of May, prices ranging from $1.25 to $2 per box of one-third of a bushel. In the early part of June, when Arkansas, southeast Missouri, Kentucky, and southern Illinois are shipping, the ruling prices are 75 cents to $1 per box. The South is destined to remain the most profitable tomato region for commercial purposes, the annual income from that source alone being already very great.

Squashes are shipped to some extent to Northern markets. They bring paying prices if properly packed and wrapped to keep from bruising. The average price is 25 cents to 50 cents per dozen.

Radishes and Lettuce are shipped to a very limited extent by experienced growers as the risks attending transit are a serious objection.

Watermelons.—The culture of this leading shipping product is practically abandoned by the market gardeners of the South and is pursued by the planters along the leading railways. Improper shipping and other casualties have frequently entailed losses on the producer. The crop is easily raised in any part of the Southern States, and is subject, therefore, to overproduction. It is heavy in bulk and requires much discrimination in selection, not always given by the planter. The crops of Florida and Georgia are the earliest in the market, coming the 1st of June, they are shipped to Eastern and Western markets, the prices ranging from $25 to $30 per hundred. With greater supply from other States the price declines to $12 to $20 per hundred, extra fine lots bringing readily $25 to $30 per hundred. About July the enormous crop of the shore of the Chesapeake Bay sends its advance guard to the seaport cities, while southeastern Missouri, a famous melon country, and Tennessee and Kentucky begin to supply the Western markets. Southern shipments continue as long as prices keep above freight charges. Melons are shipped

in bulk carloads and special rates are generally accorded to this class of freight. The varieties known in the South as "Rattle Snake," and "Kolb Gem," are popular in the market and are grown to the greatest extent.

The traffic in vegetable products exchanged between the different sections is the basis of an important branch of the interstate commerce of the United States, and a great source of revenue to the transportation lines. Could the tonnage of shipments in bulk and by express transported by the ship-lines and railway companies from the South to the North in the early months of the season, and from the North to the South in the fall and winter season, be shown by figures approximately correct, a showing almost incredible would be presented by which the aggregate value of these modest products of the field and garden might be more correctly judged. Inquiries made by the writer on this point of the various transportation companies have not been favored by desirable reponses. Some statements kindly furnished by the Louisville and Nashville Railway Company, and by the Cincinnati, New Orleans and Texas Pacific Companies, are given herewith, as follows. The Louisville and Nashville Railroad Company, for the fiscal year ending June 30, 1888, reports:

	Pounds.	Carloads.
Northward bound:		
Fruits and vegetables	105,578,000	4,339
Potatoes and onions	32,898,000	1,371
Southward bound:		
Fruits and vegetables	35,170,000	1,466
Potatoes and onions	33,308,000	1,388
In both directions:		
Fruits and vegetables	140,748,000	5,805
Potatoes and onions	66,206,000	2,759
Total	206,954,000	8,564

Melon shipments of 1888, north from Montgomery, Ala., 1,023 carloads; north from River Junction, Fla., 180 carloads.

The rapid development of the industry in the Gulf States is strikingly illustrated by the following statement of green vegetables shipped from Mobile and vicinity over the Mobile and Ohio Railroad Company, furnished by R. N. Taylor, esq., general auditor of the road:

Year.	Carloads.	Year.	Carloads.
1878	66	1884	
1879	137	1885	266
1880	189	1886	262
1881	130	1887	201
1882	225	1888	254
1883	364		688

SEED-PRODUCTION SUPPLY.

The preference given to home-grown seeds has at all times materially stimulated production of garden seeds in the United States. The capital and enterprise employed in this branch of horticulture has been attended by the greatly varying vicissitudes of success incident to the development of a new and untried industry. Experience, in many cases dearly bought, has clearly demonstrated that the highest quality and the most remunerative yield can not be expected in every locality where seed production has been attempted, but shows that a careful consideration of the soil and climatic conditions peculiar to the localities is necessary. Commercial seed-growing in the United States is, therefore, confined at the present time to certain districts offering the needed conditions indispensable to its successful pursuit, and in

these sections the largest amount of capital and enterprise are employed. The leading seed-growing firms have there their special growers, confined to the production of certain specialties ordered by the respective firms. This may be termed the legitimate branch of the seed-producing industry. Another wing is made up of extensive wholesale dealers, who buy the product offered by independent growers. It is obvious that this channel of supply can not be equally reliable as the product grown under direct order and supervision of a given firm, jealously guarding its reputation. The wholesale trade consists, in consequence, of bona fide growers and of general jobbers. The retail trade, so liberally represented in every city of the country, is supplied by the trade at large, some dealers buying exclusively from the most reliable seed-growing firms, others in the general market, with no further questions asked other than the lowest wholesale price. European seeds, so largely imported to this country, affect home-grown production considerably, as they can be produced at less cost and in larger ratio of yield in the leading transatlantic seed-growing districts; large quantities are in consequence imported, grown on special orders of the American houses.

A locality, to be fully suited to the production of the most perfect seed, must have a soil capable of producing the parent plant in its highest type of perfection. Only from a fully developed organism can a correspondingly perfect seed be reasonably expected. The lower stages of development of the parent yield necessarily the inferior grades so frequently afloat in the market. It must possess, furthermore, the full benefit of climatic conditions most suitable to the development of the floral organs producing the seed and to the normal ripening of the seed. These outward influences determine the yield and the market grade of the product. Defective development of seed-bearing organs and excesses of temperature, hastening unduly the ripening of the seed, must necessarily reduce the commercial value of the crop. The degree of moisture in suspense in the atmosphere is likewise of great importance to the full perfection of various kinds of seed, especially the cabbage family, the seed of which contains a large percentage of vegetable oil. Localities in close proximity to the ocean and the large inland lakes are, in consequence, more suitable to the production of certain seed than sections in the interior of the country. These indispensable climatic advantages are present in greater degree in northern latitudes. The universally conceded superior value of northern seed is therefore fully explained and justified. The northern climate acts, in addition, greatly in favor of seed production by its limitation on insect life, which is so antagonistic to the full development of leguminous seeds, confining their production to the northernmost latitude of the United States and Canada.

With the above climatic limitations before us, the districts of greatest seed-production are readily pointed out and the causes of their superiority explained. The cabbage seeds are principally grown along the Atlantic shore from New Jersey to Maine. Long Island is considerably noted for this production. Large quantities are grown around Newport, in Rhode Island, and the vicinity of Boston is especially noted for superior seed of the Brunswick cabbage. The York cabbage, of English origin, is mostly imported from France and Germany, but grown to some limited extent on Long Island. Peas and beans, subject to the attack of the weevil, are principally grown along the lakes and the St. Lawrence River, most largely, however, in Canada. Peas are extensively imported from Great Britain. The vine seeds—as melons, cucumbers, and squash—are procured from the central Western States, where they attain the highest development. Turnips are largely grown in Pennsylvania, but, being produced far cheaper in Europe, a large percentage of this seed is imported. The same is the case with the beet, which is, however, grown to a great extent in various sections of the North and East. Spinach has always been extensively grown for seed around Philadelphia and in New Jersey, but it is now imported extensively from Europe. Onion seed is principally grown in Connecticut

and New York. Radish seed is imported in greater part, the American product being inferior to the European.

The large seed-growing houses, requiring immense quantities, have their special growers in different localities, in order to make sure of a supply independent of the failure of one or the other section. The above quotations apply mainly to the supply of the stupendous seed trade carried on in a country so large and productive as the United States. The professional market gardener produces a fair proportion of his supply by a judicious system of seed-raising, conducted under his own supervision and by the selection of the truest types of vegetables from which to raise the seed. Home production, however, can not be continued for an indefinite number of seasons from the same stock. Northern-grown seed must frequently furnish new stock, possessing renewed vigor.

THE CASTOR BEAN (RICINUS).

This oil-producing plant is cultivated to considerable extent in various sections of the Western States. The oil extracted from the seed is used for medicinal purposes, but is coming steadily in greater demand for lubricating and other mechanical uses.

Almost any soil that will produce wheat or corn will answer for its culture. A rich sandy loam is preferable, while wet and heavy soils are unsuitable to successful culture. The ground is well prepared by plowing and thorough pulverizing of its surface. The rows are laid off with the plow 5 or 6 feet apart each way. For convenience of gathering the ripe beans, the seventh row in one direction is laid off further apart, to admit the passage of a wagon. The seed is soaked in hot water for twenty-four hours previous to planting; to insure a full stand, six to eight seeds are dropped into each hill, of which, however, only the strongest plant, or sometimes two, are left to grow. Planting is done after all danger of frost has passed, about the middle of May. Cultivation is similar to that of Indian corn. The oftener the surface is stirred the greater will be the growth. After attaining a height of about 2 feet the plants grow very rapidly and branch freely, the large, showy leaves peculiar to the plant forming a dense canopy of shade. The usual height is 8 to 10 feet. The seed is produced in pods or husks united into spikes. Ripeness is indicated by the brown color of the husks; in this state the spikes are cut off. The gathering continues from early August to the advent of the frost, and must be closely watched to prevent the loss of the beans, scattered far and wide by the popping of the pods. The ripe spikes are placed on a properly prepared floor, the action of the sun and heat causing the pods to open and discharge their seeds. The crop in this stage is very sensitive to wet, and must be kept perfectly dry. Carefully cleaning and separating from all foreign matter is the most important work before the beans are offered to the trade. One important fact in connection with the culture of the plant is its fertilizing influence on the land on which grown. In that respect it surpasses even clover. Its influence is not only valuable to the future fertility of the soil, but likewise as an exterminator of insect pests brooding in the ground. Experience has shown that where a crop of castor beans has been raised the field was free from all destructive pests, such as Chinch bugs, Hessian fly, and even moles, and remained so for a number of years thereafter. Alex. Euston, esq., secretary of the Collier White Lead and Oil Company, St. Louis, has kindly furnished the following statement relating to this industry in the United States. He says:

"The crop of castor beans in the United States varies annually from 150,000 to 350,000 bushels, the former being the yield for this season, while the latter figure was reached three years ago. During the past twenty-five years the crop has fluctuated variously, sometimes running down to as small a quantity as 50,000 bushels, and one year within that period having run over 500,000 bushels. The price this year is $1.75 per 46 pounds. Last year it was $1.60 per 46 pounds, and in 1886 the value of castor beans at St. Louis was $1.25 per 46 pounds.

"Nine-tenths of the castor-bean crop of the United States is raised in southern Illinois, southern Missouri, and southern Kansas. The remaining one-tenth is raised in Texas, Florida, and Tennessee. The number of factories employed in manufacturing castor oil at this time is thirteen, one being in Texas, three in Kansas, five in St. Louis, one in Kansas City, and the remainder in the seaboard cities. It is a crop very difficult to cultivate, and, as the yield rarely exceeds 30 bushels per acre, it is a crop only raised, as a rule, on farms remote from all railroad stations, as the high price obtained for the beans overcomes to some extent the cost of transportation. The castor bean usually crushed for the purpose of making castor oil for medicinal purposes is the small gray bean with blackish stripes. The red castor bean that is usually found on plants grown for ornament produces an inferior quality of castor oil only, and the yield from this bean is not as great as from the small variety.

Castor beans, after being received from the farmers, are carefully cleaned, assorted, and every particle of foreign matter taken from them, and then are pressed with hydraulic machinery. The present machinery in the United States is capable of crushing ten times the crop that is raised.

The American castor oil is of finer quality than any raised in the world, and the chief center of manufacture is St. Louis, Mo., where this article has been produced for the last forty-five years. The original beans, from which all the present best quality oil is made, were imported by the late Henry T. Blow many years ago from the west coast of Africa. The India bean produces an inferior grade of oil that is sold in Europe.

The best-known brands of castor oil in this country are Collier Company, of St. Louis, Missouri; the Brown Oil Company, St. Louis, Missouri; Red Seal Oil Company, St. Louis, Missouri; Belleville Oil Company, Belleville, Illinois, and Baker & Bro., of New York City, the other factories being quite small. That portion of the oil which is sold for other than medicinal purposes is used chiefly in lubricating heavy machinery and in the manufacture of alizarin assistant.

HOP CULTURE.

Hop culture stands solitary and alone among the varied agricultural pursuits, owing to the peculiarity of its different operations, the great precautions taken in the handling of the products, but not less on account of the cost of production.

No production of the farm has so wide a difference in value between the highest and lowest grades as hops, a difference frequently equal to the cost of production. None are so susceptible to injury by mismanagement or disease; none are so utterly worthless when not properly prepared; none are so limited to a single use and so variable in yield; hence the violent fluctuations in price and consequent loss in years of plenty and overproduction, or in case of inferior quality from whatever cause.

The product is raised exclusively for the brewing industry. Its commercial value is therefore solely dependent on the demand of the manufacture of malt liquors, an industry flourishing in northern climates, as in the case of the United States, England, and Germany, and other countries in the same latitude, but only sparingly represented in the warmer and wine-producing countries of Europe and America.

The plant is a rampant growing vine demanding a cool climate and rich, porous soil, in which the roots can penetrate to great depth in search of a constant supply of moisture indispensable to the development of the profuse crop of clusters bearing the floral organs. The full development and ripening of the crop occurs in the latter part of the summer in which droughts are more frequent; hence the necessity of porous and well-drained soil offering unrestricted descent of the roots. The seed-bearing organs of the plant appear in strobiles or collections of imbricated scales or

bracts, under which are yellowish aromatic glands containing the substance for which the crop is raised.

The Lupuline.—This substance is the bitter principle of the hop, and consists of numerous globules of a bright golden color, emitting a sharp, pungent odor. It is most sensitive to injury by heat or other causes, and on its preservation hinges the whole intricate routine of operations so strikingly peculiar to this branch of culture. The florescent mass of strobiles, being the crop of the plant, must be picked from the vines at the right time of maturity, which occurs when the lupuline glands are most fully developed. When picked too early the product is deficient in a certain percentage of its intrinsic value, often amounting to 40 or 50 per cent. When picked too late the loss is correspondingly heavy, as the yellow color of the glands has changed to a dark brownish tint, caused by the evaporation and loss of a portion of the essential oil of which lupuline is composed. Picking time is in consequence confined to but few weeks, and, as all must be done by hand and in a careful manner withal, the saving of the crop requires many operatives, entailing a great outlay to secure the necessary help at the time when labor is most in demand.

As soon as picked off the vines the hops are sent to the drying kiln, and here they pass through the most critical ordeal which decides their commercial value, which is frequently reduced or totally destroyed by the careless and ignorant manner in which they are handled. Hops fresh from the vines contain 75 per cent of moisture, which must be evaporated in the drying process as speedily as possible, yet in such a way as to cause the least possible injury to the lupuline contents. The latter being very sensitive to heat, it is obvious that vigilant judgment must be exercised in the degree of heat to be generated in the drying kiln, It has been abundantly demonstrated that a high temperature of 180 ° F. and over will destroy the golden appearance of the glands and exhaust a large percentage of the ethereal residues so valuable in brewing, yet notwithstanding many tons are annually wasted by excessive heat in drying, administered either in undue haste to accelerate the drying process or by reckless carelessness or ignorance of the operator. A temperature not exceeding 120 ° F. is considered by good authorities a safe degree for successful drying.

The plan of construction of a draft kiln most generally used embraces two kilns, 18 by 18 feet, with fuel room between. A storage house with two floors, respectively, 2 feet lower than the floors of the kiln, adjoin the kilns and is connected by doors. The kiln consists of two stories, the lower the stove or heating room, the upper the drying room proper. The kilns are usually built on brick or stone foundations 4 feet high above the ground, with at least two draft holes in the wall, two on each weather side, 2 by 3 feet, with swing doors to shut off the draft when required. The height of the lower heating room is 12 feet. Height of drying room 4 feet to plate, on which the roof rests. The perpendicular height of the roof is 18 feet above the plate. A ventilating hole 3 feet square is left in the center, on which a cowl 8 feet high is set in a leaning position to turn the rain. This is moved by a wind vane to turn away from the prevailing winds. Both stories are plastered, making the building air-tight from foundation to ventilator. The kiln floor is made of slats set on edge three-fourths of an inch apart. They rest on cross-beams 16 inches apart. The slats are covered by strainer cloth, on which the hops are placed, uniformly loose, in a layer 15 inches deep. The heat generated in the stove, provided with pipes distributing the emitted heat evenly throughout the lower rooms, is forced upward and through the hops by the current of air admitted by the foundation holes, carrying the moisture of the hops out through ventilation. A constant circulation of air is thus secured, which accelerates the evaparation of the moisture more than mere radiant heat could accomplish. The hops when dry are shoved off the kiln floor through the door in the adjoining storage and left to cool on the floor. The fan blast, invented by E. Meeker, of Puyallup, the largest hop-grower in Washington, is a great improvement over the ordinary

draft kiln. The inventor says on the subject: "With our fan-blast kilns a large fan is driven by steam at a high rate of speed pouring out a volume of cold air around the heated furnace and pipes below, forcing a strong current through the hops, 'waist deep,' and cures them at a low temperature in ten hours."

Sulphur fumes are used to bleach the hops and to hasten the drying process. The fumes are administered at the beginning of the drying and continued gradually to the middle of the operation, and again when the hops are nearly cured. Sulphur acts likewise as a preventive against heating in the bale and is withal indispensable in the process of curing and preserving the product. After drying, the hops are baled under strong pressure. Our American custom of baling in neat packages of 180 to 200 pounds weight, of a size 4½ by 2½ and 1½ feet, which can be conveniently handled, is far preferable to the bungling sacks or pockets and cylindrical bags in vogue in England and Germany.

The hop plant is propagated by cuttings taken from the subterranean stems, commonly called runners or suckers. Immediately under the hill is found a sweetish bulbous root or tuber connected with the crown of the hill by a string-like attachment. Quite frequently a peck or half a bushel may be found under one hill. Above these are found a different kind of roots extending laterally from the hills and gradually plunging into the ground. These are the main feeders of the plant. The slips are cut 6 inches or more in length and planted in early spring, three or more to each hill to insure an even stand, the surplus being afterwards removed. The ground is deeply plowed and made mellow, and is laid off in each direction in rows 7 to 8 feet apart. Every hundredth hill is reserved for a male or staminate plant, by which the whole field is to be impregnated. It is, however, an open question whether seed-bearing is necessary or even desirable, as the seed is generally considered a useless bulk. The vines grow freely the first season; in the Pacific States they frequently bear a crop the first year.

Culture in established fields consists mainly in deep working of the ground throughout the early part of the growing season and subduing the runners. This must be carefully attended to each season. When the vines have made their full growth and begin to set the blossoms the cultivation of the ground is discontinued. Myriads of spongioles (extremities of the feeding roots) come to the surface from this time on to imbibe the moisture of the atmosphere and the dews at night.

The vines are supported by poles set firmly in the ground. One or two poles are set to each hole, at the option of the grower. At picking time the vines are cut near the ground and the pole is raised and laid before the pickers. and when stripped of its crop it is piled out of the way. The poles are of various sizes, from 16 to 25 feet in length with corresponding thickness, and last from 10 to 15 years. Their price is, according to quality, from 11 to 25 cents. An acre of 750 hills, with two poles in each hill, requires in consequence a considerable outlay for the poles alone. Various devices of horizontal training on wires stretched along the rows and supported by intermediate posts have been tried, and have had their day, but the pole system has outlived them all and is to-day the most popular in use. The plant when once fairly established will bear crops for an indefinite number of years. In the richest and deepest soils of the Pacific States no fertilizers are required. In the Atlantic hop-growing districts manuring is a most needful requisite of the industry, especially on the thinner upland soils. Each hill receives its regular winter dressing and the land at large is enriched from time to time by stable manure and a compost, or by commercial fertilizers of which the superphosphates are the most valuable. Lime, ashes, plaster, and salt are likewise used.

A marked difference in time of maturity of the crop existing in various varieties has attracted the attention of the foremost growers, who recognize the advantage afforded in the gathering of the crop, materially reducing the pressure of picking all at the same time, and has induced the culture of different varieties, coming in

FIELD OF GROWING HOPS. C. L. PERRY'S HOP YARDS, WATERVILLE, NEW YORK.

INDIANS AT MEEKER'S HOP FIELD, WASHINGTON.

MEEKER'S HOP HOUSE, WASHINGTON.

succession a fortnight or more apart. An early variety named the "Humphrey" is coming in great favor. This is succeeded in maturity by a leading kind named "English Cluster," which in turn is followed by a later Canadian variety known as the "True Canada." A model yard made up of this succession, the property of Sylvester Gridley, of Waterville, New York, deserves special mention in this connection. The plant is subject in some seasons to the attacks of noxious insects, such as lice, and to mildew of the leaves and rust of the clusters; these evils must be borne with philosophical resignation by the grower, as there is no known preventive, or remedy within his reach.

The commercial value is graded in five classes—fancy, strictly choice, medium and good brewing, and low grade—the best grade bringing fully 25 per cent more than the lowest.

The great hop-raising district of New York State is described as beginning at a point 100 miles north of New York City, and extending northward about 50 miles, and westward about 150 miles. The climate is cold in winter, the mercury sometimes dropping 20° to 30° below zero. Its summers are seldom oppressively hot. The season, opening early and frost coming late, gives the hops plenty of time to develop and mature. The highly picturesque face of the country consists of great rolling hills, fertile to their very summits, and of charming valleys. The soil is a gravelly loam, taking kindly to the luxuriant growth of all tame grasses, making the country famous for its dairy as well as its hop industry. Hop-picking here is done by people congregated from the surrounding country and from distant cities and far-off districts. A close estimate of the annual expenses incurred by the grower for 1 acre in full bearing places actual cost at $37.77. With the average yield of 1,000 pounds per acre the cost of production of 1 pound of hops is 13½ cents. Another estimate, taking into account the material advance of late years in price of poles, places the actual cost of 1 acre's crop at $178.40, or a fraction less than 15 cents per pound. The average selling price of hops in seventeen years, from 1865 to 1881, is given at 34 cents per pound. The largest acreage cultivated by individual growers is given as 168 acres, 125 acres, 75 acres, etc. (See Pl. XXXIV). The hop region of Washington Territory is the basin of the Puget Sound. This fertile lowland lies between two mountain ranges, running parallel with the Pacific coast. The basin is watered by various rivers fed by the snow-capped mountain peaks. One of the rivers is the Puyallup, famous already for its hop production along its banks, where the soil and climate are peculiarly suited to this culture. Rich crops of hops of highest quality are a never-failing certainty there. The famous plantations and drying kilns of E. Meeker & Co. are located there.

The picking of the hop crop of the Territory is done by Indians, who come from all parts of Puget Sound, from British Columbia, and even from the confines of Alaska. (See Pls. XXXV and XXXVI.) The cost of producing the crop of 1 acre is estimated at $168. The average crop is 1,600 pounds per acre, making the cost of producing 10 cents per pound. The cost of picking and uncertainty of the timely arrival of sufficient numbers of straggling pickers are the only checks restraining this industry from assuming in the near future far greater proportions than at present.

W. A. Lawrence of New York is inventor of an ingenious process of extracting the lupuline contents of the hop and preserving them in hermetically-sealed packages for future use, unimpaired by deterioration or loss of the aromatic essence. Extensive works, capable of extracting 20,000 pounds of hops per day, are in operation in Waterville, N. Y., which is the center of the hop region of that State. The value of the process so successfully conducted by the inventor must be apparent to every one acquainted with the fluctuations of the hop market, and with the losses sustained by growers in years of overproduction and low prices, scarcely covering the price of production, or with injuries sustained by the crop from outward

casualties. Quantities unsalable for any cause at remunerative figures can be shipped to these works, where every atom of their lupuline contents is extracted and saved to the producer. The lupuline is liberated from the leaves by a volatile solvent. The solvent is in turn evaporated, leaving the valuable lupuline parts as a substance resembling tar in outward appearance. The commercial value of the hops having been thus extracted, the residue is a valuable fertilizer for the hop plant and is eagerly bought by the hop cultivators.

The rate of production in the different States and Territories is shown by the following table, compiled from the United States census reports of 1850 to 1880:

States.	1850.	1860.	1870.	1880.	Acreage, 1880.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
California	....	....	625,000	1,444,000	1,119
Illinois	9,550	7,250	104,000	7,700	21
Indiana	927,000	27,800	63,800	21,200	69
Maine	40,000	103,000	296,800	48,200	219
Michigan	10,600	60,600	828,200	266,000	491
Minnesota	....	....	222,000	10,900	30
New Hampshire	257,000	130,000	99,400	23,900	59
New York	2,536,000	9,671,000	17,558,000	21,629,000	39,072
Oregon	....	....	9,700	244,000	304
Pennsylvania	22,000	43,000	90,600	39,000	83
Vermont	288,000	638,600	527,900	1,109,200	294
Washington	....	....	6,000	703,000	534
Wisconsin	15,900	135,500	4,630,000	1,966,000	4,439

A decline in production is noticed in Illinois, Indiana, Maine, Michigan, New Hampshire, Pennsylvania, Vermont, and Wisconsin, which will be found still greater in the Census of 1890. Corresponding to the decline in States less suited to hop culture is the increase of production in New York, California, Oregon, and Washington. On the Pacific slope production shows the greatest increase since 1880, especially in Washington Territory, which is to-day the largest producer next to New York, and offers the greatest climatic advantages, besides a virgin soil of greatest fertility. Distance from the commercial centers, sparseness of population, and other drawbacks incident to a new country may continue to temporarily check the rapid extension of this industry. The superiority of its product, however, must necessarily place the Territory at the head of hop-producing sections of the United States.

THE CANNING INDUSTRY.

The wide-extended commercial interests concentrated in the preservation of perishable food products in hermetically-sealed vessels are conventionally known as the canned-goods or packing industry. Packing, the word generally used, is a misnomer in this connection, applying principally to the meat industry. The canning industry, mostly concentrated in the city of Baltimore, has a trade journal exclusively devoted to its interests. The editor, E. T. Judge, esq., has kindly furnished the following data of the history and present extent of the industry:

"While much has been asserted respecting its origin, it can be directly traced to the inventive genius of one Mons. Appert, who published a small work early in the present century, describing his method of keeping food of all kinds—fruits, vegetables, meats, and fish—in nearly their natural state by excluding the air and using sufficient heat to destroy any vital germs that might remain in the contents of the sealed vessels. This work seems to have had a very slight demand. Only a few copies are known to exist, and much improvement has been made on its methods. It seems to have been first used commercially for the preservation of oysters, there being still in possession of one Baltimore firm some cans of these goods put up in 1825. Later on the process was applied to corn in New York and the New England States, one of the pioneers in the business dying but a few months ago. From 1840

to 1850 it got a footing in several of the Atlantic States, the oysters and fruits of Maryland offering special inducements, as they are, to a great extent, peculiar to that section, and were not then susceptible of transportation to great distances in their natural state. Large amounts of these were put up by a number of firms and several hundred per cent. profit realized annually. This financial success resulted in two things, viz, greatly improving the methods and facilities for handling and attracting capital to establish new houses. The civil war greatly increased the demand for these fresh-preserved foods, and since that time factories have increased rapidly. With the growth of the business came necessity for increased culture of the products used by the canning houses, and it may be said that a new agricultural field was opened by this industry. As an illustration of its effect, it is noted that where berries of different kinds usually sold in their season at Baltimore at about 1 cent per quart previous to 1860, they now command 5 to 10 cents per quart, or even higher, although they are extensively cultivated now and rapid transportation and demand stimulates the production and gathering of them. The same is true of peaches. From a retail value of about 10 cents per peck previous to the war they have risen to an average of 30 cents per peck in the Baltimore market, which is the central market of the great peach region. Peas show even greater increase in value, the prices having risen since the establishment of the canning industry at Baltimore from about 40 cents per bushel (in the pod) previous to 1860 to an average of $1.20 per bushel in 1888. Retail dealers state that they do not now on a market day sell one barrel of green peas where they sold twelve in years gone by, before the packers took such large quantities. The reasons are, first, the increased price of the green peas, and, secondly, the greater satisfaction from the canned peas, which are all of one size in the can, being sifted and graded.

Baltimore is mentioned in these instances, as it is the greatest canning center in the United States. The articles named are but little packed in other regions, and the extent of this at this point has caused the local populace to complain that the growth of the canning industry has greatly increased the cost of fruits and vegetables. The same is true of oysters. The people of Baltimore now pay as much for oysters as do those of Chicago and St. Louis, which cities are nearly 1,000 miles from the supply.

Its Development.—It is only within the past ten years that the great extension of the canning business has occurred. Maine, New York, New Jersey, and Maryland seemed all at once to realize that there was a great market for these goods. This was in large part due to the low prices of grain in the Western States, rendering farming in the Atlantic States an unprofitable occupation. About 1881 a great number of small farmers began canning, and attention was mainly given to corn and tomatoes, prices of which ruled at or above $1.25 per dozen cans, the corn can holding 27 ounces and the tomato can about 41 ounces. During 1883 the amount packed was so great that the price fell to about half this figure for the average goods, and a great many small packers were ruined. Meantime the industry had gotten foothold in the Western States, and the number steadily increased in all parts of the Union. The packing of fine fruits in California had been in operation for some years, and about this time they began to get a strong hold on the best markets of the eastern half of the country. One of the most notable circumstances connected with the growth of the industry is the fact that the establishment of a canning house in any fresh section seemed at once to create a market. It stimulates demand in its neighborhood by educating the rural population to a better or more varied bill of fare than the farmers were accustomed to, and hence the business has not as yet reached a point of fullest expansion. Although it was supposed that 1883 carried over to 1884 fully 25 per cent of its product, the two following years witnessed an increase in the number of packers and the output; but at the opening of 1887 prices advanced sharply on nearly every article, because the

market was cleaned up, showing the consumption had been greater during those two preceding years than the production. 1888 has witnessed a repetition of 1883, with much loss from low prices, but the recovery will be rapid.

We are, however, not far from the point where an increase of canning factories will overdo the average yearly demand, and when this point is reached the business must soon settle to a basis of lowest profitable prices, and take its place in competition with other food products. At present the growers generally known as "truckers" realize very much higher profit per acre than do farmers in general; but as many of the canners produce their own fruits or vegetables a reduction in the price of the canned goods really only means a lower profit from their farms. There are at present in the United States about 1,700 canneries for food of all kinds, including fruits, vegetables, meats, fish, and milk. Almost every variety of fruit is canned; of vegetables nearly all are included except the tubers and roots. It is as valuable to the fish industry as to the horticultural, as the now world-wide consumption of salmon and oysters will testify. In meats and milk the advantage is more one of economy than of condition.

The heaviest item in the list of canned goods is sugar corn; then, next in order, tomatoes, peaches, berries, beans, pears, and pineapples—the latter not of domestic growth. The balance of the vegetable list is of small pack compared with these.

By States the number of canneries is as follows:

Alabama	2	Wisconsin	6
Colorado	3	Florida	7
New Hampshire	4	Louisiana	10
Rhode Island	4	North Carolina	10
Connecticut	5	Alaska	11
Kentucky	5	Tennessee	11
West Virginia	5	Michigan	30
Arkansas	15	Oregon	31
Mississippi	15	Missouri	35
Minnesota	16	Texas	38
Indiana	20	Iowa	40
Kansas	20	Pennsylvania	41
Washington Territory	23	Ohio	48
Nebraska	24	Delaware	51
Massachusetts	25	Illinois	52
California	70	New York	159
New Jersey	100	Maryland	473
Virginia	109		
Maine	146	Total	1,690
Georgia	6		

Canada has 128 canned goods packers, including all in the British Dominion of North America.

Corn is packed from Maine to Texas, very little, however, in the Gulf States, and none in California, the corn worm being too prevalent. Tomatoes are packed from the 44th parallel south to the Gulf, the main pack being, however, in the Middle Atlantic States, the season being too short in the Northwest to make it profitable. Peaches are packed mainly in the Delaware-Maryland section of the Atlantic coast and in California, but Arkansas and Texas are rapidly developing in this direction. The Lake region was once prolific, but the yellows destroyed most of the Michigan orchards. Berries are canned in all sections, New York State and the Western States having largely increased their output in recent years. The middle South is one of the greatest berry fields of the continent. Tennessee, Georgia, and Arkansas largely supply the upper valley. Pears are packed mainly in New York, Mary-

land, and California; apples in New York, Ohio, and Indiana; pumpkin and squash almost exclusively north of the 40th parallel, where it is also consumed.

The average pack of corn for the past three years has been about 3,000,000 cases of 2 dozen cans each, or 72,000,000 cans. An average yield of sugar corn is 2½ tons per acre, weighed in the husk. Packers buy it by the ton at about $7 to $10 per ton, according to locality. It requires about 4 ears to the can, or 100 ears to the case, for the moist-filled cans, and 50 per cent more for the dry-packed cans, or in round numbers about 40,000 of sugar corn to supply the present demand.

Of tomatoes, the average pack has been for some years about 2,500,000 cases of two dozen cans each. An average yield of tomatoes, with good annual fertilizing, will be about 250 bushels to the acre, or about 8 tons (2,000 pounds), which are delivered by the grower at from $6 to $8 per ton. It would therefore require annually about 20,000 acres to supply the fruit to fill the 60,000,000 of cans, about the present consumption.

In peaches the values are much higher. It is carefully estimated that the annual pack of peaches reaches 1,250,000 cases of two dozen cans each of all grades, three-fourths of which are packed in the Chesapeake Bay region. Peaches are graded as pies, second quality, standards, and extras; standards for about two-fifths of the pack, the others one-fifth each. As an average of price, peaches cost about $1 per bushel. Paring and stoning greatly reduces the bulk. About 15,000,000 bushels are needed for a full supply of this fruit. Some 18,000 barrels of granulated sugar are used in the sirup for this fruit in the canning.

Of green peas there are about 1,200,000 cases of two dozen cans each packed annually, of which Baltimore packs about 900,000 cases, the total pack requiring about 1,000,000 bushels of peas in the pod. The yield is dependent altogether on the season, but will average about 30 bushels per acre. They have to be carefully picked, the pickers going through the field each day and taking only the young but newly matured pea. It requires an army of pickers in season, which lasts on the eastern half of the continent from May to July, and in California from May to October.

String beans are packed all over the country, with steady growing demand. The other articles mentioned are each of more limited extent, but in the aggregate make a great volume.

There are employed in the 1,700 canning houses of the United States about 1,360,000 hands in summer season, many of whom have work through the year in other than the fruit and vegetable line. The collateral necessary trades, such as can-makers, box-makers, label-printers, and machinists, in the mechanical supplies for canners will add as many more, and the field hands required are one-fourth more. The tin plate now imported and used for this industry amounts to 1,500,000 boxes, worth nearly $6,000,000, used only as a necessary wrapper for this food. The development of machinery for use in the canning houses is very great, and it will be but a short time before there will probably be an exposition of the development that will surprise the world.

The fruit and vegetables are packed in the season in the following orders: Peas, berries, cherries, string beans, peaches, tomatoes, corn, plums, okra, lima beans, pears, grapes, cauliflower, spinach, dandelion, pumpkin, sweet potato, squash, hominy.

CHAPTER XXI.

PEANUTS: THEIR CULTIVATION AND COMMERCE IN THE UNITED STATES.

By ALEX. McDONALD.

The cultivation of the peanut in the United States is confined mainly to the States of Virginia, North Carolina, and Tennessee. Its origin is not definitely known, but it is believed with some degree of certainty to have been introduced into this country by slave ships from the coast of Africa. Norfolk is the center of the trade in Virginia, and from data obtained in that city I derive the most of my information. It is only within a comparatively recent period that the peanut has become an article of commerce. Fifty years ago it was raised in small patches in some of the eastern counties of Virginia, but went little, if at all, into trade. Now it has become a crop of no small magnitude.

Salem, Massachusetts, was perhaps the largest importer of the few foreign peanuts brought to this country among the other articles from the African coast. The French and Portuguese settlements on the west coast of Africa have always had the principal monopoly of the trade in nuts, though the English share it somewhat with them. Marseilles, France, is by far the largest market in the world, using about 50,000 tons of shelled nuts per annum. Amsterdam and the other Dutch ports probably come next, while England consumes a few. These are exclusively used in making oil—in fact, the quality they receive would not be fit for fancy use and eating, as ours are. The trade is suffering now for the reason that there are so many other oil seeds utilized—rape seed, mustard seed, cotton seed, cocoanut—that prices follow in the comparative scale.

The Rue Fisque and River Gambier (Africa) nuts are perhaps the best, and Goree, Freetown, Bathurst, and Sierra Leone are the principal shipping points, none coming from the south of these points.

The first impulse given to the trade in America was during the late civil war, both sides taking a hand, but mainly from different motives; the South to manufacture oil for lubricating, table, or medical purposes, according to necessity, and the Northern army for eating purposes. At any rate the trade in nuts made a start and increased rapidly, and the nuts were imported freely, notwithstanding the import duty was very high.

New York dealers in 1866 estimated the crop for the year as follows: North Carolina, 125,000 bushels; Virginia, 75,000 bushels; imports from Africa, 6,000,000 bushels. Values then were, for Virginia, \$3.50 to \$4 per bushel of 22 pounds; North Carolina, \$3.25 to \$3,50 per bushel of 28 pounds; Africa, \$2.50 to \$2.75 per bushel

of 32 pounds We have no quotation of the Tennessee product, though that State was then reported as supplying a share of the Pittsburg and Cincinnati demand.

The following figures, taken from the *Cincinnati Price Current*, made up at great cost and labor and accepted by the trade as reliable, show the extent of this industry and its growth in the United States :

Total United States crop.

Year.	Virginia.	Tennessee.	North Carolina.	Total.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
1887-'88	2,250,000	500,000	75,000	2,825,000
1886-'87	1,800,000	750,000	100,000	2,650,000
1885-'86	1,800,000	800,000	150,000	2,750,000
1884-'85	2,000,000	1,250,000	300,000	3,550,000
1883-'84	1,500,000	800,000	150,000	2,450,000
1882-'83	1,250,000	460,000	140,000	1,850,000
1881-'82	825,000	250,000	75,000	1,150,000
1880-'81	1,500,000	750,000	120,000	2,370,000
1879-'80	1,350,000	750,000	120,000	2,220,000
1878-'79	875,000	425,000	90,000	1,390,000
1877-'78	405,000	325,000	100,000	830,000
1876-'77	780,000	500,000	125,000	1,405,000
1875-'76	450,000	235,000	100,000	785,000
1874-'75	350,000	200,000	120,000	670,000
1873-'74	225,000	175,000	60,000	460,000

Peanuts (arachides) are cultivated and grown in many other parts of the world The advance in agricultural knowledge keeps pace with the times. Madras and Calcutta, in Asia, have them to sell. Surinam, South America, furnishes a supply for the Antilles. They are now no strangers on the Sandwich Islands. New Zealand and Tasmania enter largely into the production, machinery for the manipulation of them going from Virginia. California a few years ago produced large crops, but has discontinued growing to any extent, at least for shipping.

Of the Virginia crop of 1887–'88, estimated at 2,250,000 bushels, it is claimed that as usual about four-fifths, or 1,800,000 bushels, will find a market to be handled at Norfolk.

Prices are ruinously low for the producers, yet, with all that, at a money value of 60 cents per bushel, $1,100,000 was received for them last year.

There are in Norfolk four large substantial brick four-story mills, built and expressly fitted up with costly and elaborate machinery run by powerful steam engines, for the picking, cleaning, assorting, shelling, and polishing of the nuts for the dealers and jobbing trade, which give direct employment constantly to between 600 and 800 persons, male and female. The investment in mills and machinery may be put at $125,000. The amount disbursed for handling the crop may be shown by the value as expressed above; and the output spreads from Canada to Texas and westward to Salt Lake City, Omaha, and other points.

CHAPTER XXII.

THE FRUIT INDUSTRY IN THE UNITED STATES.

By H. E. VAN DEMAN.

In the absence of any accurate statistics on the subject, the fruits of the United States may be roughly estimated to be next to the cereals in market value and in importance as a staple article of food. Certainly not less than $300,000,000 worth is annually produced in this country.

Almost every kind of fruit is grown in one section or another, from the hardiest species in cultivation in northern Europe to those belonging to the tropics. There is scarcely a farm or a small city lot that is not planted, to some extent, in fruit.

It is true, there are many careless and improvident country people who do not make full use of their advantages for growing fruit for daily use, but it is encouraging to note that this is becoming less common. The city markets are usually well supplied, and sometimes are flooded to such an extent with berries and other fresh fruit that it is sold at a loss to both growers and dealers.

The means for drying and canning are becoming so well established and understood that such misfortunes are not likely to occur so frequently in the future.

Organizations of fruit-growers are also yearly increasing in number and size, which look to the better preparation for market and more timely and judicious distribution of the fresh product.

The constantly increasing settlement of wild regions is opening up new territories and new markets, and fruits are now being grown where a few years ago it was thought they could not be grown. This is especially true of Dakota, Montana, Wyoming, Colorado, New Mexico, Arizona, and parts of Texas, Kansas, Nebraska, and Florida. It may be that these sections of the country may have to abandon some kinds that are now being tried, but there are other kinds which are being each year originated or introduced that are surprisingly successful.

In the older settled portions of the country the insect enemies and fungus diseases are making such havoc with almost all kinds of fruits that the National and State authorities, as well as scientific experts and private fruit-growers, are forced to devise some means for destroying them.

EVAPORATED AND DRIED FRUITS.

Within the last twenty years there has sprung up an immense manufacture and sale of evaporated fruits in the United States. This is chiefly due to the invention of improved apparatus for evaporating, which are now in general use in all sections where fruits are grown, except in California.

Western New York, Pennsylvania, Ohio, Michigan, and Oregon may be said to

yield a large share of the evaporated fruit product. This consists principally of the apple, peach, pear, cherry, prune, blackberry, and raspberry.

This industry is carried on in many other States to more or less extent. There are many large factories where hundreds of bushels are worked up daily.

In California the extremely dry air and absence of rain and dews during the latter part of the summer and fall are so favorable to sun-drying of fruits that evaporation by artificial heat is rendered useless. In California the drying of fruit is one of the leading industries. Quite a large trade in dried grapes for export to France and other countries, for making into wine, has sprung up in California, where the varieties of *Vitis vinifera* flourish and produce abundantly. The making of raisins is largely on the increase, especially in the San Joaquin Valley. Samples of evaporated and sun-dried fruits may be seen in the exhibit of the United States Department of Agriculture at Paris, during the continuance of the Exposition of 1889.

CANNED AND PRESERVED FRUITS.

Baltimore, Maryland; Rochester, New York; and St. Louis, Missouri, are beyond doubt the centers of the canned-fruit industry east of the Rocky Mountains, and San Francisco, San José, Sacramento, and Los Angeles on the western or Pacific side. There are canneries in almost all parts of the country, but the bulk of the fruit is canned and preserved in the immediate vicinity of the cities just named.

It is not my purpose or privilege to give in this brief report more than a mere outline of the more important species grown and their approximate success or failure in the various States and Territories.

THE APPLE.

Of all the fruits that are cultivated in North America, the apple stands at the head in point of quantity and practical importance as an article of food. There is not a State or Territory in which it does not succeed to a reasonable degree, except in Florida and Arizona. It is true attempts have been made there also, but with very meager results. In other sections the apple does not prove entirely successful; and along the coast of the Gulf of Mexico and in the extreme northern part of Minnesota and westward to the Rocky Mountains it may be said to be a failure.

On the Pacific slope the climatic conditions are quite different, and I have seen and eaten apples of fair quality grown from Puget Sound to Mexico. Oregon and western Washington seem to be very favorable to apple culture.

That part of the country bounded by the Great Lakes and the St. Lawrence River on the north, the Atlantic Ocean on the east, a line extending from Savannah, Georgia, westward, to Fort Worth, Texas, as a southern limit, and northward from there through central Kansas, Nebraska, and Dakota on the west, and including the southern portions of Minnesota and Wisconsin, may be said to be the apple region of the United States east of the Rocky Mountains.

Western New York is one of the most productive sections; but perhaps no more certain to produce large crops than Michigan, the mountain regions of northwestern Arkansas and western North Carolina. This latter region is, owing to its altitude (2,000 to 5,000 feet above the sea) and other physical conditions, one of the best adapted for the growth of good keeping winter apples in the entire country.

The apples of northwestern Arkansas do not keep so well as those of some more northern regions, but yet they are much better in this respect than the latitude would indicate. Southwestern Missouri is, in all respects about the same. The prairie regions of eastern Kansas and Nebraska, southern Iowa and western Missouri, may safely be said to be the largest body of rich land suitable to the growth of the apple in North America. Like in most other sections, extremely cold winters or spring

FLUME CONNECTING WITH MAIN IRRIGATION CANAL, RIVERSIDE, CALIFORNIA.

frosts sometimes kill the fruit buds, but generally there is a good crop, and it sells at an average of 25 cents per bushel in the orchard.

The largest apple orchard in the country belonging to one person or firm is that of Wellhouse & Wheat, of Kansas, consisting of 597 acres.

The leading winter varieties in this region are Ben Davis, Winesap, Jonathan, Willow, Ralls Genet, and Missouri Pippin.

In the northern parts of Nebraska, Illinois, Indiana, and all of South Dakota, North Dakota, Wisconsin, and Minnesota, great difficulty is experienced in apple-growing, because of extreme cold. Occasional winters have been so severe as to kill the orchards, in whole or in part, except of a few very hardy varieties, such as Oldenburg and Wealthy. However, there are very hopeful signs that varieties have been originated or imported from northern Europe that may meet the requirements.

Michigan, New York, and the New England States grow different varieties of winter apples from all others. The Baldwin, Rhode Island Greening, Roxbury Russet, Northern Spy, Esopus, and Red Canada being among the most popular of the winter kinds.

In Georgia, Tennessee, Texas, and portions of adjoining States yet another list of varieties seem to be necessary, of which the Shockley, Nickajack, Gilpin, and Minkler are in general favor as late keepers. It would be very tedious to enumerate all the varieties which succeed in the various localities, and their seasons of ripening.

THE PEACH.

This fruit may be considered as the next most popular in the United States. It is grown in all sections south of Maine, New Hampshire, and Vermont, although west of Lake Erie the line of successful culture trends more to the southward, leaving the northern half of the States of Indiana and Illinois, and all of Iowa and Nebraska and the more northern States without the successful region.

On the Pacific slope, California is peculiarly well adapted to peach culture. The broad rich valleys and genial climate afford every natural advantage except water, and that is being rapidly supplied by systems of irrigation. The same is true of New Mexico, Utah, Arizona, and western Colorado.

In almost all the rest of the country the peach crop is subject to occasional (and in some places frequent) winter-killing of the fruit buds, or by the spring frosts when in bloom.

The peninsula lying between the Chesapeake and Delaware bays, including all the State of Delaware and a part of Maryland, is quite exempt from these troubles. The same is true of a narrow strip lying immediately west of Lake Michigan, and popularly termed "the Michigan peach belt." It may seem strange, but it is true, that this strip (some 10 miles wide) reaches north nearly to the Straits of Mackinaw.

The most dread disease is a malady called "peach yellows" which infests parts of these two sections. It is not scientifically understood, and no remedy seems to have been found practically effectual, aside from cutting out the trees. It is generally thought to be contagious.

Georgia contains some of the largest peach orchards in America. The varieties generally in cultivation, except in the extreme South, are of American origin, and of the Persian type. The most popular are named in their order of ripening as follows: Amsden, Alexander, Troth's Early, Crawford Early, Mountain Rose, Elberta, Old Mixon Free, Crawford Late, Smock, Heath Cling, Salway.

In southern Texas and the regions near the Gulf of Mexico the Spanish and southern China types find more favor, because those just named will not succeed.

In central Florida still another from China, called the Peen-to race, is the only one that will endure the warm climate.

The original Peen-to is very oblate in form, but some seedlings of it are now of the usual round or oblong shape that the common peach assumes. This latter class puts out its leaves very early, and ripens the fruit in May or even earlier.

THE PEAR.

This delicious fruit is grown in every part of the United States except the extreme northern parts of Wisconsin, and a belt lying westward and northward to the Rocky Mountains. In some sections the winters are very damaging to the tree, but experiments are being made which promise to overcome this trouble. Varieties of this character have been imported from northern Europe.

In Florida, Georgia, and southern Texas, where the ordinary varieties do not succeed, crosses between the common European pear and the Chinese Sand pear have proven very well suited. This is peculiarly true of the Le Conte and Keiffer, although the quality of the fruit is only medium. Many of the leading varieties grown all over the country (with the exceptions just mentioned) were brought from France and Belgium, and it may be truly said that these have been the basis of all the good pears we grow.

There are very few extensive pear orchards in the eastern United States, and they are mostly in Georgia and Texas, planted of the Le Conte variety, for northern shipment.

In the neighborhood of Rochester and Geneva, New York, and Boston, Massachusetts, there are many small market orchards composed largely of Bartlett, Angouleme, Anjou, Flemish Beauty, Seckel, and Sheldon.

In California and Oregon the pear is planted much more largely for market purposes in the fresh, dried, evaporated, and canned state. This is owing to the exemption from blight which is experienced only there ; for in the Eastern, Central, and Southern States this dread disease renders profitable pear culture very exceptional.

THE PLUM.

Although the European varieties of the plum (*Prunus domestica*) are very valuable, they are produced under great difficulties, except on the Pacific coast, because of the curculio stinging the fruit and causing it to drop in most parts of the United States. This insect has never appeared on the western side of the Rocky Mountains.

In California, Oregon, Washington, Arizona, Utah, and western Colorado this fruit is a perfect success, and thousands of acres are planted for drying and canning purposes. Fruit is there abundantly borne, of the largest size and most delicious quality, and the Eastern States are largely supplied from this source. However, there are a few favored places in the Eastern States in which the curculio, is rather scarce ; such is western Michigan and parts of New York and the New England States where a crop is often gathered. There is a strain of this species of Prunus, called Damson, that bears quite regularly over a greater area, but the fruit is small and rather acid.

In addition to these, and owing to their greater exemption from, and ability to recover from the attacks of the curculio the native North American species, *Prunus chicasa*, *P. americana*, and *P. umbellata*, have been taken into cultivation. There are thousands of wild varieties of these species that are quite edible, both in the fresh and cooked states. Many of them have been named, and the trees are sold by nurserymen all over the country.

Within the last twelve years a number of Japanese varieties of *Prunus* have been imported, and are now being tested with encouraging results, so far. Some of them are very large and of superior quality, and a few have flesh almost blood red.

THE CHERRY.

All the varieties of the cherry cultivated here are either of European origin or seedlings having that parentage.

What is called the Morello class is grown in all parts of the country, but the Bigar-

reau and the Kentish varieties do not succeed in the Southern and Central States because of the inability of the tree to withstand the peculiar climatic conditions. In all the Pacific States they do remarkably well, and especially in Oregon and Washington.

THE APRICOT.

The cultivation of this fruit is virtually confined to California, Utah, Idaho, and portions of Arizona, Colorado, and New Mexico, because of the ravages of the curculio. In these parts it is grown to perfection. In California thousands of acres may often be seen from one point, covered with apricot orchards bending under their loads of fruit. Canning and sun-drying is extensively carried on, and the Eastern markets are well supplied from this source.

Now and then a few apricot trees may be seen in the Central and Eastern States but they rarely mature the fruit because of the curculio.

THE QUINCE.

This is a fruit that is rarely grown in orchards of even an acre's extent, but a few trees are found in the grounds of almost every intelligent fruit-grower in the whole country, except in Florida and Texas, in which States it does not seem to do well. It thrives best in cool, moist soil. The fruit is in great favor for making preserves and jellies, and is sometimes eaten stewed with a little sugar, but is not eaten in the raw state. A species from China having very large fruit is being introduced, which is proving valuable in the South.

THE GRAPE.

The genus *Vitis* is well represented in the United States. There is not a State or Territory in which at least one species is not found, either wild or cultivated. California is, above all other sections in North America, the paradise of the grape. Both hill and valley seem to produce fruit of the highest excellence and in profusion. Twenty tons have been grown on one acre, and 10 tons is quite common. The species grown there is almost exclusively *V. vinifera.* There are vineyards of over 2,000 acres in extent in a continuous stretch and belonging to one party. There is scarcely a named variety of grape in Europe or Asia that is not or has not been under trial there. In Utah, Arizona, New Mexico, and southwestern Texas this class of grapes is successful, and in Florida to some extent also. But the most popular class of grapes is of native origin. The varieties have been produced from generations of wild seedlings, some of pure native stock and some with a little foreign blood in them. There are frequent hybrids between the species, some accidental and some the result of careful breeding. It would be difficult to select the most successful regions, for the native grapes flourish almost everywhere, from the Great Lakes to the Gulf, and from the Atlantic Ocean to the Rocky Mountains.

Ohio, Missouri, Illinois, New York, and Virginia are the States which produce the most largely.

Concord is perhaps the leading variety, but there are others which are becoming strong competitors with it.

Delaware and Catawba are more delicately flavored, and Niagara is one of the best of the very light-colored varieties.

Grapes are grown mostly for table use in the fresh state, except in California, where they are largely made into wine and raisins.

THE STRAWBERRY.

The first fruit that greets the careful tiller of the soil in the spring is the strawberry. It is found in the gardens in almost every State and Territory, except

northern Alaska, and in almost all parts of them. As it requires much moisture, it must be irrigated in California and other sections where the rainfall is light. In the Mississippi Valley and eastward there is much attention given its culture. There is no berry so commonly grown and with which the markets are so well supplied. Florida growers begin to ship in January, and supply the fancy markets in the Northern cities at a very high price. Georgia, Alabama, Mississippi, Tennessee, Arkansas, and Texas follow about April, and at a much lower price, for the distance to market is less and the area of culture much greater. Refrigerator cars are run on fast time, so that the most distant cities in the North are quickly supplied.

As the season advances the date of ripening moves northward, so that the strawberries of Minnesota and eastward into Maine prolong the season into July. New Jersey is one of the States most largely engaged in the culture of this fruit. Kentucky and southern Illinois, eastern Ohio, and Pennsylvania furnish a large share of the market supply in the middle of the season.

No methods of preserving the strawberry other than by canning in a solution of sugar and in jelly, are worthy of notice.

THE RASPBERRY.

One of the most delicious of small fruits is the raspberry. It begins to ripen before the strawberry is out of season and continues for about a month. All the native varieties in cultivation belong to two species. Those known as the Cap varieties sprang from *Rubus occidentalis*, which grows wild in most of the Central and Eastern States. Most of them are black in color, but a few are yellow or whitish when ripe. The plant propagates by the tips of the long drooping canes taking root.

Rubus strigosus is the parent of the other class, which is found wild in the northern States. It propagates by suckers or sprouts from the roots, and not by the tips taking root. The fruit is very soft and nearly always of a reddish color. A few varieties are yellowish. The fruit of both species is abundant in the markets in the fresh, evaporated, and canned state. Large areas are devoted to its culture, which is usually quite profitable.

THE BLACKBERRY.

This is strictly a native North American fruit, being found wild all over the continent. There are two species in cultivation, but the one of most importance is *Rubus villosus*. It grows about as high as a man, and sometimes higher in rich soil. The plant is covered with stout prickles, which are quite annoying to the grower. The fruit is one of the most delicious and popular of the summer season and exceedingly wholesome. It is grown for market in large fields, but owing to the fact that the wild fruit is so easily obtained the blackberry is not often grown in a small way for household use, except on the Western prairies, where it is not abundant in the wild state.

The best varieties in cultivation have nearly all been found wild and are accidental seedlings. In Iowa and the States northward the bushes have to be bent to the ground and covered with earth or other material to protect them from injury during cold winters. There is a species (*R. canadensis*) with prostrate stems, native to the Northern States, that is being brought under cultivation. Still another (*R. trivialis*), of similar habit, grows in the South, and both are termed "dewberries," although the fruit is almost identical with the common blackberry except that it is about two weeks earlier. The prickles are long and recurved, and are very troublesome to the fruit-picker. The trailing habit makes some sort of a trellis necessary, and which is not required by the upright growing species.

FIELD OF SHAFFER'S RASPBERRY, NEAR ROCHESTER, NEW YORK.

THE CURRANT.

We have a wild species (*Ribes aureum*), which is found along the wooded streams of the Western plains, which bears black fruit of rather good quality, but the leading cultivated varieties are from the European species (*R. rubrum*). Those States lying south of Virginia and Kentucky, and west of Missouri, except Colorado, are not very suitable to the growth of the latter varieties; but inside of this boundary line the fruit is a staple article of household use. It is not grown for market except in a small way, but is in almost every fruit garden.

As with nearly all European fruits, varieties have been produced here which are better than those imported. In the extreme northwest corner of the country, including Oregon, Washington, and southern Alaska, the conditions are also suitable to its growth.

THE CRANBERRY.

This is a fruit that requires very peculiar conditions. It is truly a marsh plant, being found wild in the bogs of the extreme north only. There are vast areas now yielding no revenue, especially in northern Wisconsin, Michigan, Minnesota, and perhaps Alaska, that may be made very profitable when planted to the cranberry (*Oxycoccus macrocarpus*). It is now cultivated in all the States named, and also in New Jersey and Massachusetts. The strip of land forming Cape Cod is almost one complete cranberry plantation.

The plants seem weak and slender little things (being only about 6 to 12 inches high), but the crop they bear is so immense that they are sometimes harvested by being raked into piles. The berries endure very rough handling, and being of a dark red or crimson color, are attractive in the market. They are shipped in barrels all over the country and to England and Europe with perfect safety, and will keep sound until spring. Being of a very sharp but pleasantly tart flavor, there is no fruit that makes a more delicious sauce. It is hoped to introduce it to the popular favor of the people of foreign countries, to whom it is highly recommended.

THE GOOSEBERRY.

Although very popular in England and some parts of Europe, we do not here consider it as one of our choicest fruits. It succeeds better in Oregon and Washington than elsewhere; but the native species (*Ribes hirtellum*) does fairly well all over the central and eastern states where the European (*Ribes grossularia*) is badly affected by a fungous disease called "mildew."

The native varieties are smaller, but bear most abundantly. The markets are well supplied, but no extensive field culture is needed to meet the demand. South of Virginia and Kentucky the gooseberry does not succeed well.

THE DWARF JUNE BERRY.

There is in North America a genus called *Amelanchier*, which grows wild over a large territory. One species (*A. oblongifolia*) is dwarfish in habit, as it does not exceed 5 or 6 feet in height, and often less. It bears a small dark purple berry-like pome in great abundance, which ripens in June. It is sweet and very pleasant to the taste of most persons. The plant is thornless, endures the climate of almost the entire country, and is of easy culture. It is becoming quite popular, especially on the Western prairies.

CITRUS FRUITS.

THE ORANGE.

Within the last twenty years orange culture has increased in the United States very rapidly. Central and southern Florida and a narrow strip along the Gulf coast as far west as New Orleans comprises the orange region east of the Rocky Mountains. On the Mississippi River delta south of New Orleans there are some very productive orange orchards, but occasional cold spells have been quite damaging in this locality, as well as along the entire Gulf coast and in northern Florida. In fact, as far south as Sanford and Orlando the fruit was caused to drop in January, 1886.

This State is, however, well suited to orange culture, for no other freeze of like severity has happened since the planting of the orange there. A few oranges have been grown in southern Arizona, and it is thought that a good degree of success will eventually result. Irrigation is there a prime necessity. In California this industry is assuming magnificent proportions. The orange is planted from the Mexican border to within sight of Mount Shasta, which covers a range of fully 600 miles north and south. There are occasional frosts which injure the fruit, but success is the rule.

At Riverside and other places in San Bernardino and in San Diego counties are especially productive orchards. Some of the most beautiful orange-orchard scenes in America are at Riverside.

The fruit is shipped from California to the eastern markets during March, April, and May, and finds ready sale. In quality the fruit of this State is rather tart and the rind thick, but in beauty is superior to that of any other section. Irrigation is commonly practiced in orange culture all over California.

In Florida the production of oranges for market was not largely carried on prior to the war of the rebellion. There were large groves of the sour orange growing wild in the forests which had come from stock that had been brought over by the Spaniards hundreds of years ago. Many of these old Spanish settlements having been abandoned long ago, these wild seedling orange groves appeared as if they were indigenous. They were gradually taken into cultivation, thinned out, and the branches cut back to force the growth of young sprouts, which were budded to sweet oranges. Some of these wild groves are among the most profitable estates in Florida. At present orange-growing is the principal business of the State and planting is rapidly increasing. The fruit is very thin skinned and sweet flavored, but there are several insects which cause a discoloration of the skin that injures the appearance of a part of the fruit. No irrigation is practiced in Florida orange orchards except in very rare cases where artesian wells have been sunk, and these have been in operation but a very short time.

THE LEMON.

Lemon culture is of quite recent date in the United States. It is only within the last ten years that there have been enough grown to send to market. But there is fast increasing interest shown in the business, and large orchards have been planted, and each year adds to their extent and number. Although the lemon requires a milder climate than the orange there is no doubt that there are in southern Florida and California large tracts of land suitable to the growth of lemons of high character. Many ignorant persons have allowed the fruit to grow too large, and some have depended upon poor varieties; but these matters are being understood, and the market dealers are learning to appreciate the fact that as good lemons can be grown n this country as anywhere in the world. New seedlings have been grown, and the best varieties have been imported from the Mediterranean regions, so that we now

GATHERING WASHINGTON NAVEL ORANGES, SANFORD, FLORIDA.

have only to proceed intelligently in order to greatly reduce the importation of the foreign product, if not drive it out entirely.

THE LIME.

This is a still more tender tree than the lemon, but in southern Florida, and perhaps California, there are sections where it may be grown with success. There has already been something done in the way of manufacturing citric acid from the lime in Florida, but the price is too small to make it very profitable. Varieties are now being grown that are as large as lemons and of the very best quality.

THE POMELO.

This fruit is of quite recent introduction from the East Indies, and has only been offered on the northern markets for the past five years. It is botanically known as *Citrus pomelanus.* The popular but improper name "grape fruit" has crept into use, which was given because of the fruits growing close to each other on the ends of the pendant branches. It is very large (averaging about one pound) and of a lemon color. The pulp has a very pleasant acid taste, but the rind is bitter. It is growing in popular esteem quite rapidly.

TROPICAL FRUITS.

THE DATE.

The date palm has been tested in many of the warmer parts of the country and borne fruit in several cases, but the experiments have all been on a small scale. Arizona and southern California give promise of the best results, and it is thought that the time is coming when the date culture will there be carried on commercially.

THE PINEAPPLE.

The only place where this fruit succeeds within the United Stated is in southern Florida. It is grown in the central part of that State to some extent under a winter covering, or sort of shed, but on the islands and mainland south of Charlotte Harbor on the west coast, and from Merritts Island southward on the east coast it is grown by the acre. Along Indian River and at Lake Worth are many very successful plantations of the pineapple

THE BANANA.

It is grown in about the same places as the pineapple, but so far very little is done in a commercial way, as the plant is very tender and the price of the fruit is very low, because of the large importation from the West Indies and Central and South Americas.

THE COCOANUT.

The most successful plantations of this tropical tree are about Lake Worth, which is on the eastern coast of Florida. There are thousands of trees bearing there and many acres of young ones.

THE GUAVA.

Although very tender, this fruit is grown more or less all over Florida, except in the northern part, and very rarely in California. In some places in Florida it is considered a staple article of food, and is used for jelly, marmalade and other confections.

There are many other fruits of a very tender character which are being tested with success, such as the mango, sapodilla, and Avacado pear, but the trees are generally only beginning to bear.

MISCELLANEOUS FRUITS.

THE FIG.

Ever since the first settlement of the country the fig has been grown in a small way, and in all the Southern States and Territories with success. At St. Augustine and other places in Florida, in Alabama, Louisiana, New Mexico, and California there are some very old fig trees. In the milder parts of the country it is grown and used to make preserves, and in the fresh state, but it is not sold in the markets or dried for sale, except in California. In that State it grows to perfection, and large orchards have been planted recently for drying purposes. This is especially true of Tulare and Fresno counties. The air is very dry during the ripening season, and this affords just the desired conditions for curing by solar heat. The same is true of Arizona also, and it is expected that we will soon produce within our borders all the figs we need.

THE OLIVE.

This fruit has long been grown in a small way in Florida and California, and within the last twenty years it has been made a practical success in the latter State. There are vast regions there in which it will succeed. Oil is now being made and sold in the markets. Pickled olives are also put up to some extent.

THE KAKI.

Some twenty years ago this fruit (*Diospyros kaki*) was introduced from Japan, and is now growing all over the southern part of the country, but it is not hardy in the Northern States. The fruit is beginning to be sold in the large cities and meets with much favor.

There are many other fruits of more or less value that have been introduced from foreign countries, and a few native kinds that are likely to become popular after further trial.

I trust that the brief mention here made of the fruits and fruit industry may add something to the fund of human knowledge, and that whatever mistakes may have been made will be looked upon with forbearance.

OLIVE ORCHARD AND VINEYARD OF GEORGE F. HOOPER, SONOMA, CALIFORNIA.

CHAPTER XXIII.

VITICULTURE IN THE UNITED STATES.

First Division.—Exclusive of California.

By B. F. CLAYTON.

VINE CULTURE.

General Observations.—The total area in vineyards in the United States I estimate at 400,000 acres, of which California has 200,000 and the other States the remainder. The period of development of American viticulture may be said to be practically limited to the last twenty-five years. A few sporadic attempts were made earlier by Nicholas Longworth, of Ohio, and a few others, but no substantial progress appears to have been made beyond attracting public attention to the fact that grapes could be grown and wine made, viz, the possibility of American viticulture was demonstrated. The industry as it is to-day is, therefore, the creation of the last quarter of a century. During that period it has taken definite form, and although in the morning of its existence, shows robust character and phenomenal development.

In the grouping of divisions or districts adapted to the cultivation of the vine it will be well to bear in mind that the area of the United States (not including Alaska) is a little over 3,000,000 square miles, an acreage larger than all Europe except Russia, and the population about 60,000,000. Although the population is comparatively sparse, railroads and inland navigation open ways through nearly every part of this vast territory, so that the rapid development of any natural resources or industry is certain; and when it is considered that in 1870 the entire wine product of the country was only about 3,000,000 gallons, and that it is now 40,000,000, it is not unreasonable to look for a mighty development of this industry in the next quarter of a century. Looking at the map of the United States, we find it divided by the conformation of its surface, climatic conditions, soils, etc., into four grand divisions. First—The great Pacific Plateau, covering all that area west of the Rocky Mountains, having a climate more or less Asiatic. This area includes the States of California and Oregon and the Territories of Nevada, Arizona, Utah, Idaho, and Washington, and extends 2,000 miles north and south by 800 to 1,000 east and west. In favorable localities in this region, particularly California, the *vinifera* can be cultivated as successfully as anywhere in Europe or Asia. Second—Coming east of the Rocky Mountains, a vast area extending to the Mississippi Valley stretches out, known as the "Great Elevated or Western Plains." Some portion of this district is occupied by what is known to geographers as the "alkali deserts,

or rainless plains," but it is for the most part hilly in the west and level and rolling toward the eastern limit, and presents fertile plains of enormous extent, watered by innumerable rivers and streams. Throughout this region we find distributed many varieties of our native grapes, including chiefly Cineria, Rupestris, Mustang, and some representatives of the Riparia and Æstivalis, showing that a system of viticulture could be built up here when the people come who are appointed to do the work. Third—Coming still farther east we reach the great "Central Plains," embracing the area known as the Mississippi Valley. This is a region of unsurpassed fertility, and already has a successful system of viticulture established at many points and undoubtedly possesses enormous capabilities in this repect. Fourth—and lastly, we note the "Eastern Grand Division," embracing the elevated lands of the Appalachain system of mountains, including the Allegheny and Blue Ridge Mountains and their foothills, and the great "Atlantic Plains." In contemplating the soil and climatic characteristics of these grand divisions the first thing to consider is the adaptability of varieties and species. The "Plateau Region" of the Pacific, as before stated, has an Asiatic climate, and it is natural to suppose that the vinifera will be the chief basis of viticultural development. Indeed, this has already become a fixed fact in California, and that State is already producing many million of gallons of wine annually of the same general character as the European wines and the basis of a successful system seems to be securely founded. The Phylloxera has appeared there in a few localities, but so far seems to have made but little progress, owing, doubtless, to both climatic and soil conditions. Crossing the Rocky Mountains to the "Great Western Plains," we are confronted at once by a climate differing essentially from that on the western slope. Great extremes of heat and cold, sudden and devouring north winds and frosts, rainless areas, drouth and deluge. The tender vinifera could not, therefore, be relied upon to build up a system in this region, but it is clear that they are not needed, for native vines of rare excellence are found growing wild in many places throughout its extent. The Cineria, Rupestris, Mustang, Æstivalis and their crosses and hybrids show the source and point the way to the proper line of work to the future vine-growers. Coming to the "Great Central Plains," the Mississippi Valley region, the Riparia and Æstivalis seem to find their natural habitat, with part or all those mentioned as natives of the grand division of the "Elevated or Western Plains," and are already utilized to establish many successful vineyards. Reaching the "Eastern Grand Division," we find the Riparia, Labrusca, Rotundifolia, Munsoniana, and Coriacea scattered through the various States comprising this district. Nature has been bountiful with her viticultural gifts, and there is no lack of timber upon which to found a great and successful system. Climatic conditions bar out the V. vinifera in all these three last grand divisions, except perhaps a few localities in the Southwest, and the vine-growers must inevitably look to the native varieties. Experimental work should be pushed on these lines. Indeed, advanced American viticulturists recognize this fact, and propagators are working out the problem of success from these sources. If what is already known were reduced to practice and generally disseminated, our present system would be revolutionized and American viticulturists would attain a plane of success that would command the attention and patronage of the whole world.

WINE-MAKING, PICKING, AND MARKETING THE FRUIT.

It is not deemed expedient, owing to lack of space, to go into any detailed description of the various wine companies' buildings and plants, and only a few typical ones will be noted here and others shown in the illustrations. The first, and perhaps the oldest one, is "The Pleasant Valley Wine Company." This company is located at Rheims, Steuben County, N. Y. in the Pleasant Valley district, near the end of Lake Keuka, being the oldest and most extensive wine house in the

State. Organized in 1860, the first year it used a trifle less than 20 tons, gradually increasing its business and adding new vaults, until at this time it consumes about 1,000 tons, or 2,000,000 pounds of grapes. Its annual output is about 8,000 cases of champagne and over 200,000 gallons of wine. Its brands are Great Western, Carte Blanche, and H. B. Kirk's Special. These are sold in the cities of the United States exclusively. The still wines are sold as Dry Catawba, which is natural wine, or Sweet Catawba, as the name indicates.

Port, or heavy, sweet, red wine, and claret are a natural red wine fermented on the skins. A small amount of brandy is distilled, some 3,000 to 5,000 gallons each year. The sparkling wine is sold by the case to consumers at $12 for quarts, $14 for pints; Dry Catawba at 65 cents per gallon in barrels, $4 per case at wholesale; Sweet Catawba at same price; Port at a little more, and brandy at $4 to $5 per gallon. The grapes are received on the upper story, where they are crushed by a large steam-power mill, the pomace falling on the platform of the presses through a chute. On the floor are two large double-acting steam-power presses, having a combined capacity of 36,000 gallons per day. From the press room the must is carried by large pipes to the fermenting rooms below, where it is received in large fermenting tanks, holding from 500 to 3,000 gallons. The process of fermentation and handling the young wine is the same as employed everywhere, and need not be described here. The method of making the sparkling wine is the same as practiced by the French in producing their finest champagne, and is well known as the "Long process" by fermenting in the bottle. It takes nearly two years for its completion.

The New Urbana Wine Company is located on Lake Keuka, a few miles from the above place, and is almost identical with that above described in point of size, capacity, kind, and quality of wines, still and sparkling. The following description from Mr. H. W. Crabb of his cellars and plant at Oakville, Cal., represents a typical (and I might say) model California wine-grower's establishment. Mr. Crabb says: "My grapes are gathered in the vineyard into boxes holding about 40 pounds, and are hauled to the cellar, weighed, and emptied at a rate of 10 tons per hour into the elevator that carries them up and empties them into the crusher and stemmer. The stems and grapes are separated by a shaft with teeth 6 inches long set spirally and running at 400 revolutions per minute over a perforated sheet-iron concave, through which pass all the skins and juice, while the stems are carried along by the spiral motion and thrown out. The juice and skins fall into a box 14 inches long by 7 wide, with convenient openings, and with a fall of 1 foot in 10. are carried by gravitation directly into the presses or into tanks as desired. The white grapes are generally run into tanks from the crusher and left there about twenty-four hours, when the juice is drawn off and the pomace shoveled into cars and run to the presses, situated in the center of the cellar. After pressing, the pomace is shoveled into cars and run outside of the cellar and dumped into tanks to ferment, with the addition of water, which is drawn off and distilled for brandy. The pomace is then carted out and dumped on the ground, and is either hauled out on the vineyard or used as fuel for the steam power the next fall. The juice or must has in the meantime been pumped into open tanks until fermentation is well started, when it is pumped into puncheons or double-headed tanks to finish. The juice and skins of the black grape pass down the chute into open tanks to complete their fermentation on the skins, which generally requires from 6 to 8 days, when the wine is drawn off and pumped into tight tanks. The pomace is pressed, carted off, and thrown on the ground along with the white. The presses have two baskets, each holding the pomace of about 5 tons of grapes and requiring about half an hour's time each to press, with a pressure of about 300 pounds to the square inch. While one basket is being pressed the other is being emptied and filled. The presses are worked by a double hydraulic pump connected with the main shaft, which runs the whole

length of the cellar, at one end of which is located a crusher and a stemmer to work white grapes, and at the other end are located two for crushing black grapes. The capacity of each is 10 tons per hour. The main cellar consists of three buildings side by side, each 200 feet long by 60 wide. The second cellar stands at one end at right angles to the main cellar, and is 200 feet long by 30 feet in width, and the third cellar is 60 by 30, holding in the aggregate 800,000 gallons of cooperage. A seventy horse-power boiler and sixteen horse-power engine are located in the distillery building 100 feet distant from the main cellar, power being transmitted by a half-inch wire cable to the main shaft. The distillery consists of one wooden still of about 1,000 gallons capacity and one copper of about 350 gallons capacity, the former is used to make singlings which are redistilled on the copper, which; having a doubler and three water baths, produces a clean spirit of 170 to 180 strength. This is again reduced with water to 101 for brandy. The building is 100 feet long by 60 in width. All the large cellars in the State are now operated by the same machinery—that patented and manufactured by J. L. Heald, Crockett, Contra County, Cal.

Of pruning and training, Mr. Crabb says, the Zinfandel, Mataro, and Burger are pruned short, that is, two buds on each spur ; the others are pruned long, that is, two or three canes of two feet in length are left on each vine and tied up to a long stake. These canes are removed at the next pruning and others left to be tied up as before ; some short spurs of two buds are left to produce wood for the next year. The Burger is a very heavy bearer, ripening late and in favorable soil and location producing a very good white wine of the hock type. The Zinfandel is pruned short, is a good bearer, and produces in some localities a very good claret. The Mataro is also pruned short, is a heavy bearer, ripens late, and produces a good claret in favorable localities. La Folle Noire, Chasselas, and Carignan are pruned long and produce large crops of medium quality. The Black Burgundy is an unauthenticated grape, is a heavy bearer, and produces a rich, heavy wine of good body, deep color, and fine quality; it requires to be pruned long on fairly good soils.

SECOND DIVISION, CALIFORNIA.

By GEO. HUSMANN.

The last vintage in California was in the main a good one, though not as large as was expected early in the season, nor so fully utilized for wine-making as it would have been had the prospect for a ready sale of wine and the prices paid for grapes by the wine-makers been better.

The estimates are made variously at from 16,000 000 to 20,000,000 gallons of wine, but 16,000,000 may be a fair estimate. The long protracted drought and great heat the latter part of the season brought sunscald to many vineyards, and especially to the Zinfandel, so far our leading claret grape, and as the prices for wines of former vintages were yet very low, averaging from 12 to 20 cents per gallon, wine-makers were reluctant to buy grapes, and a large amount of Zinfandel sold even as low as $6 to $8 per ton, which did not much exceed tbe picking and hauling. The grapes were also, in many instances, somewhat deficient in sugar, though yet rich enough, at European standards, to make good, sound wines, with 10 to 12 per cent of alcohol. Rieslings brought about $15 per ton, delivered at winery, which may also be called the price for other white grapes, such as Chasselas, Palomino, and Sauvignon Vert. There are, however, some instances where as high as $30 and even $40 per ton were paid for choice varieties, such as Semillion and Cabernet Sauvignon, showing that our wine-makers begin to recognize quality as a great factor in making trade, a

GATHERING RAISIN GRAPES, SOUTHERN CALIFORNIA.

view which, I am sorry to say, has not generally been entertained before. Prices for young wines so far are also very low, and but few sales have been made, as the dealers have full stocks on hand and rarely purchase until after the period of assessment for taxation, in March. The prices paid so far have been even lower than last year, ranging from 12 to 15 cents per gallon for new wine when whole cellars are purchased. The industry therefore presents a rather discouraging aspect to-day. To this may be added the alarming spread of the new disease, which, for want of a better name, has been called the black rot and which threatens to obliterate the vineyards in the southern part of the State. As far as I have been able to ascertain, it is a fungoid disease and a vitiation of sap, causing complete stagnation or, if I may be allowed the term used in the animal kingdom, blood-poisoning. It bears a striking resemblance, in many of its symptoms, to the pear blight of the East, and may be attributed to similar causes. So far it has appeared mostly in irrigated vineyards, and as a disease similar to it appeared in Napa and Sonoma in 1881, after a late and immature growth of the vines in the fall of 1880 and a sudden sharp freeze, we may surmise the cause to be similar to that of the pear blight, *i. e.*, sudden and rapid changes of temperature when the roots of the vine are surcharged with moisture, cause this vitiation or sap-poisoning. This cause may be a sudden excess of heat as well as cold, and it seems this is often the case in the south, where irrigation in June and July is followed by burning heat in August. So far as I have been able to learn, it has only appeared in irrigated vineyards or those not naturally well drained, where there was stagnation of water around the roots; and I hope yet that our hillside vineyards, on well-drained soil and without irrigation, will never know it.

Be that as it may, however, it will have a tendency to decrease our production, especially of sweet wines and brandies, which were mostly made in the south, where they freely acknowledge now that they can make at the best but indifferent dry wines. There are several other causes which lead me to believe that the wine production of California will decrease one-third in the next three years instead of increasing. Among these I will name the following:

The Phylloxera.—While this little insect does not make the rapid progress it made in France, yet its inroads are very perceptible in our best dry light-wine districts, especially in Sonoma and Napa, where its ravages can be seen in every vineyard. As so many of our vine-growers have neglected to plant resistant vines, although they have proved an unfailing remedy, they now reap the fruits of their negligence in seeing their vineyards disappear and having wine cellars without wine.

Improper Selection of Varieties.—In the preceding years, when every one rushed into planting vineyards, the majority thought that anything would do. An immense amount of red-wine grapes have been planted in localities and on soils where they will never make a choice red wine. This has been the cause of wholesale production of some very inferior wines, which remained a drug in the market, and ought to do so. Many of these vineyards are on land which produces fine raisins, and, as these have sold at good prices, and realized the owners a handsome and immediate profit, their Zinfandels and other varieties will be grafted with muscats or other raisin grapes, thus increasing that product and decreasing the production of inferior wine.

The Drying of Wine Grapes.—This was done to some extent last season, and the product has brought very satisfactory prices, from $15 to $20 per ton for the ripe grapes before they were dried. The dried grapes have sold at from 3 to 4½ cents a pound, with a seemingly unlimited demand, and if these prices can be obtained next season a very large amount of wine grapes will be dried. (Pl. XLI represents a view in a raisin-grape vineyard at gathering time.)

Low Prices of Wines and Grapes.—The prices ruling last fall have induced many of our vineyardists to leave their grapes on the vines, as they thought they would

not pay for picking and hauling. These men will not naturally care much for their vineyards; they will be neglected and to a large extent abandoned. Many are now already planting fruit trees among their vines, with the intention of uprooting the latter when the trees are old enough to bear. This will again decrease the product of our vineyards, and as but very few new plantations will be made under existing circumstances, we cannot count on a large increase from new plantations.

This may not be a very bright picture of one of our main industries at present, yet I think it is a true one, and believe it will eventually lead to a brighter future for those who persevere. The consumption of really good California wine is steadily increasing, and all these causes combined will rectify many of the mistakes made in the past—improper selection of soils and of varieties, and inferior handling of inferior wines—which have so far been a bar to the appreciation of our really good wines, which we can make as well and perhaps better than any other country on the globe. These causes will naturally tend to raise the prices. We have an abundance of good grape lands; in fact, the best have hardly been occupied or utilized; we have a bountiful production compared with Europe; can make salable wines every season, without adulteration, from the pure juice of the grape; we are learning fast to use all the natural advantages, and our machinery and apparatus for wine-making are already the wonder and admiration of the world. As an instance, I will quote that the crushers and stemmers at Vina, Gov. Stanford's winery, are capable of working up 480 tons of grapes in 12 hours.

We have an unrivaled climate and a productive soil. We have made the first advance in our young industry within thirty years, and if we are not perfect yet we are far ahead of other countries after their first century of experience.

I am fully convinced that a good time is coming for all who have really good locations for producing fine, light, dry wines. The area for producing these is limited here, and we must get rid of the idea that they can be produced anywhere within the limits of the State. Those who persevere indefatigably and experiment thinkingly will reap a rich reward for their labor in the end. It will be a case of the "survival of the fittest" in this industry as well as in any other. Hundreds will fail who entered the ranks years ago with high hopes of making a fortune in a few years, without practical knowledge or the stamina to acquire it. But the remainder, those who know no such word as fail, will survive and succeed—indeed, are succeeding now. The opening of the Wine Exchange at San Francisco, under the auspices of the State Viticultural Commission, is a step in the right direction, and will enable the producers of really fine wines to obtain good prices for them.

As to the raisin industry, which was languishing worse than our wine industry only a few years ago, it has revived wonderfully since better methods of packing—resulting in a more uniform product—have been adopted, and the last season shows a pack of about 1,025,000 boxes of 20 pounds each, nearly all disposed of now at satisfactory prices. This is an advance of about 30,000 boxes over last year's crop, and may well be considered an enormous increase over former packings and shipments. In fact, the California raisin bids fair to drive the imported entirely out of the market of this country. May we not hope that our wines will do the same at no distant day, when our pure and skillfully made products receive the attention and patronage we are confident they will deserve when we have progressed beyond the more initiatory steps of this great industry?

GATHERING MAPLE SAP VERMONT.

SUGAR-HOUSE FOR EVAPORATION OF SAP (VERMONT).

CHAPTER XXIV.

THE SUGAR INDUSTRY OF THE UNITED STATES.

By H. W. WILEY.

The discussive sugar industry of the United States may be divided into four sections, viz: maple, sorghum, sugar beet, and sugar cane. The object of the exhibit has been to set forth some of the facts connected with the industry and call attention to the possibilities of its development.

MAPLE SUGAR.

The maple-sugar industry of the United States is carried on chiefly in the New England States. Large quantities of maple sugar are made, however, in New York, Ohio, and Indiana. The maple sap which is obtained in the spring contains from 2 to 10 per cent of pure sucrose, no other sugar being found in the sap until it begins to deteriorate later in the season. The large percentage of sucrose mentioned—viz: 10—is only found in certain conditions where the flow of sap is very small. The average sap contains, perhaps, not more than 3 per cent of sugar. The sugar maple (*Acer saccharinum*) is commonly known as the rock, hard, or sugar maple. Other species of maple, however, are used for sugar; among these may be mentioned the *Acer dasycarpum*, which is known as the white, silver, soft, or river maple. The *Acer rubrum* is known as the red, swamp, or water maple. The quantity of sap obtained varies with the situation of the trees, their age and size, the nature of the season, meteorological conditions, and the methods of tapping. It is generally expected that trees on a high elevation will yield sap which is sweetest, but not so great in quantity. The warmest and most protected groves give the earliest flow of sap and with the least interruption. About 160 trees upon an acre of ground are thought to give the best results. It is almost impossible to obtain a correct statement of the amount of maple sugar and molasses made in the United States. The groves usually belong to small farmers, who often do not keep an account of the amount of sugar made, and no systematic attempts have been made to collect accurate data, except once in 10 years, at the time of the decennial census. The annual production may be reckoned at 35,000,000 pounds of sugar and 1,750,000 gallons of molasses. The value of the maple sugar produced annually is about $3,500,000, and of the molasses about $1,350,000. In round numbers the total value of the maple production of the country annually may be placed at $5,000,000. Plates XLII and XLIII represent, respectively, the method of gathering the sap, and a sugar house, such as is commonly met with in Vermont.

The exhibit shows samples of the maple sugar put up in various forms and the photographs give views of the maple groves, the methods of securing the sap and manufacturing the sugar.

SORGHUM SUGAR.

The *Sorghum saccharatum*, or sorghum cane, has been cultivated in the United States for about thirty-five years. Up to the present time but little sugar has been made therefrom, but it has been the source of a large part of the domestic supply of molasses. The amount of sorghum sugar produced in the United States during the past year was about 700,000 pounds. The quantity of molasses made from sorghum annually in the United States is enormous, but the same difficulties attend the collection of data in regard thereto as have been mentioned above for maple. The amount of molasses manufactured from sorghum in the United States annually may be placed at about 30,000,000 gallons, and its value is probably $9,000,000. The value of the sorghum sugar made in the United States annually may be roughly estimated at $40,000. During the past two or three years the process of diffusion has been introduced in the sorghum growing countries, and the amount of sugar which is annually made from that plant may now be expected to rapidly increase.

In regard to the parts of the country best suited for the growth of sorghum, experiments have shown that the semi-arid or the central portions of the country are probably well adapted to the production of sorghum of a high sugar content. The greatest success heretofore has attended the growth of sorghum in Kansas (See Plates XLIV and XLV). There every is reason to believe, however, that other portions of the country, especially Arkansas, Indian Territory, and the northern part of Texas and Louisiana, may be found equally as favorable to sorghum-culture.

The object of the exhibit is to show the sugar and molasses in the raw state as produced from the sorghum cane, with photographs showing the fields and factories where the sugar is produced and the methods and machinery employed therein.

Extensive investigations of sorghum as a sugar-producing plant have been made by the United States Department of Agriculture and published in various bulletins of the Chemical Division. The bulletins still available containing information in regard to the sorghum-sugar industry are those numbered 17, 18, and 20.

BEET SUGAR.

Many parts of the northern portion of the United States, including New England, northern New York, Ohio, Indiana, Michigan, Wisconsin, Iowa, and Nebraska, have a soil and climate well suited to the production of a sugar beet rich in sugar. The high price of labor and other economic difficulties have, however, prevented the progress of the industry in these localities. On the Pacific coast, viz, in California, extremely favorable conditions for the production of beet sugar obtain, and all the beet sugar made in the United States during the past year was manufactured in that State, and chiefly at the Western Beet Sugar Company's factory at Watsonville, California. The amount of beet sugar manufactured at this large factory during the past season was a little over 3,000,000 pounds. Another beet-sugar factory is operated at Alvarado, California, but no exact data have been obtained in regard to the amount of sugar made at that place. In round numbers it may be said that the total output of beet sugar in the United States during the past season was about 4,000,000 pounds, of a value of about $200,000. Unfortunately, the exhibits of beet sugar which were shipped to the Department from California were lost in transit, and no samples, therefore, are placed on exhibition.

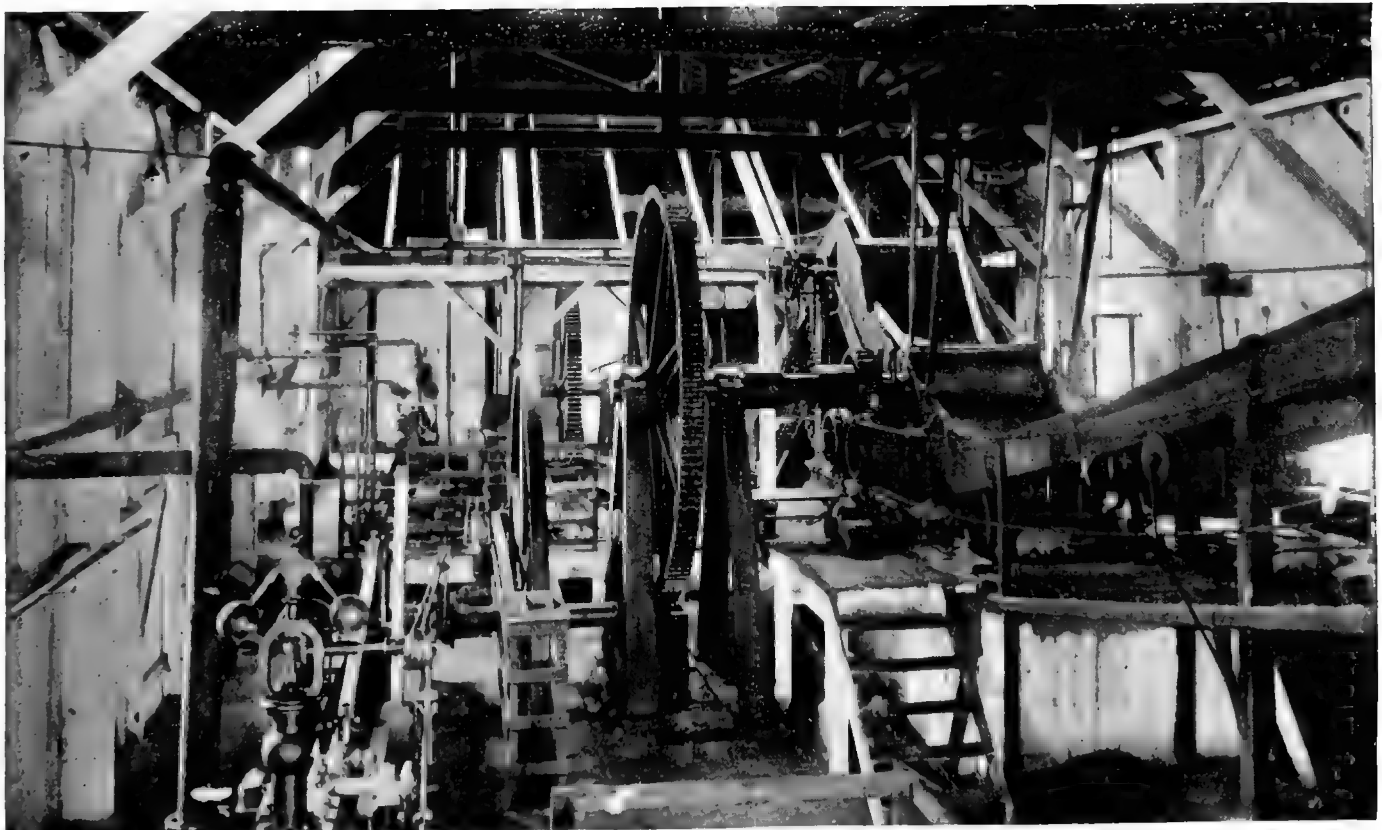
CANE SUGAR.

The cane-sugar industry of the United States is confined to certain portions of the extreme southern parts thereof, chiefly in the State of Louisiana; numerous

FIELD OF RED LIBERIAN SORGHUM, EXPERIMENT STATION, U. S. DEPARTMENT OF AGRICULTURE, STIRLING, KANSAS.

METHOD OF PRESERVING SORGHUM SEED, STIRLING, KANSAS.

CALUMET SUGAR PLANT, PATTERSONVILLE, LOUISIANA.



CANE MILL, SUPPLANTED BY DIFFUSION IN 1889, NOW USED FOR DRYING CANE CHIPS FOR FUEL.

sugar plantations are also found in the State of Texas and a few in the State of Florida. The annual production of cane sugar in the United States is about 300,000,000 pounds, but it varies greatly with the season, some seasons being much more favorable to its production than others. With the exception of about 30,000,000 pounds, this whole crop is produced in the State of Louisiana. Under the old milling process as used in that State, with open-kettle boiling, the average yield of sugar per ton was not much over 100 pounds. With the new process of diffusion and vacuum boiling, as high as 240 pounds per ton have been obtained. The percentage of sugar in the juice of the sugar cane in Louisiana varies from 10 to 15 per cent, the average for the whole State being probably 12.5 to 13 per cent. The life of the sugar cane is not over three years, the wet, cold winters practically destroying the stubble in that time. Many planters replant their cane fields every two years. For this reason the cost of plant cane is one of the most considerable items of expense which the planter has to meet. In spite of these difficulties of climate, however, with the new processes which have been introduced the increase in the production of sugar in Louisiana will be very rapid, and in a few years we may confidently expect to see two or three times more sugar produced than at the present time.

The photographs exhibited show in a very striking manner the characteristics of the Louisiana sugar plantations, the residences and factories of the planters, and the general methods employed in handling the cane in the field at the factory. (See Plates XLVI and XLVII.)

CHAPTER XXV.

THE TEXTILE FIBERS OF THE UNITED STATES.

By CHARLES RICHARDS DODGE.

WOOL.

In the classification of agricultural products which has been followed in the installation and arrangement of United States exhibits, Section VIII, under the division of commercial vegetable products not food, is devoted to textile fibers. At the very outset of the arrangement we are confronted with a product of American husbandry, and a textile of great importance in our national economy, which does not belong to the vegetable kingdom at all, but is an animal product, namely, wool. But as the production of wool is a source of income to the American farmer, as well as a source of wealth to the textile manufacturer, it was decided that there was no other place for it in the general arrangement, and it is therefore placed at the head of the list of American textile products.

The sheep of the United States are mainly of the Merino type. More than three-fourths are American Merinos and their grades. The improvement of the Spanish Merino in this country has been in progress since the first year of the present century, commencing a little later than the French, Silesian, and Saxon modifications of the same race. It is a larger sheep than the Saxon, and smaller than the Rambouillet. The fleece is of medium fineness and length, and is remarkable for its density. It is, of course, a clothing wool with superior felting quality, and naturally adapted to carding purposes.

The English breeds, generally known as mutton breeds, producing the combing or worsted wools, have been introduced from time to time, and their progenitors of the seventeenth and eighteenth centuries were brought over with immigrants from the first, yet the numbers were few and their status comparatively low until the advent of the Merino, the rise of the factory system, and the invention of spinning and weaving machinery. The sheep of the thirteen States of the Federal Union a hundred years ago were all of coarse wool breeds. Even now, there are many flocks in the South that are only partially improved by later developments either of English or Spanish blood. The sheep of Kentucky are mainly of more recent improvements of English breeds. There are many flocks in other States of the Ohio Valley of the true combing wools. Yet Ohio and Michigan, the great woolgrowing States of the interior, adhere to the Merino type. The public lands of the Rocky Mountain region, the plains of Texas, and the pasture areas of the Pacific coast are occupied almost exclusively by Merino grades in the woolgrowing enterprises of

these regions. Many Mexican sheep were used as foundation flocks, to be sure, on account of their proximity and cheapness, and they are rapidly improved by Merino crosses.

The carpet wools of the United States are of Mexican origin, Spanish originality, but not Merino. Their wool is coarse and harsh, and a fleece of two pounds weight is a good average. The scarcity of this wool, which is too cheap and poor for profit, has led to importation to supply the carpet manufacture, which has monopolized the carpet supply of the country.

The rise of manufactures, from a production valued at $80,000,000 in 1860 to a product of more than $300,000,000 at this time, has caused a demand for combing or worsted wools which could not be met by the existing flocks, and invention has come in and overcome a difficulty which could not be well met by woolgrowers, and now the great volume of Ohio and Michigan grade Merino wool is manufactured by the aid of new machinery, by the combing process, into the worsted fabrics of the most approved styles. Thus carding wool is transferred to combing wool, and the English breeds, however desirable for mutton, are no longer needed, especially for worsted goods.

The product of American wools increased in twenty-five years from 60,000,000 to 300,000,000 pounds. Recently the product has slightly declined, but the present tendency is toward increase again. The present product is greater per capita than the entire consumption of domestic and foreign wools, including imported woolens, in the period of 1851 to 1860. The statistician of the Department of Agriculture, Mr. J. R. Dodge, summarizes the facts as follows: "Including the imported goods, the consumption then was not more than 4½ pounds, while now it approximates 8 pounds. Then about two-thirds of the small requirement was manufactured at home; now about four-fifths. Then one-half of the small quota of wool was of domestic production; now two-thirds, or, exclusive of carpet wools, not then required or used, three-fourths."

Exhibit 1 of the wool series comprises 90 specimens of the principal breeds of sheep and their crosses, grown for their wool in this country and contributed by the producers. These are all the specimens which have been selected from the wool collection in the Museum of the Department of Agriculture and which, at the time the collection was made, represented some of the best flocks in the country.

Four exhibits representing the commercial aspect of the wool interest are next presented, furnished by the following well-known firms: Messrs. Justice Bateman & Co., of Philadelphia, Pa., Walter Brown's Son & Co., of Boston, Mass.; William McNaughton's Sons and John Lynch, both of New York City. These samples are commercially graded, according to the classification of the wool trade, and are picked samples of the wool clip of the season of 1889. This series comprises 68 numbers from 91 to 159, there being duplicates of a majority of the specimens for the inspection of experts who may wish a closer examination than can be afforded by case specimens.

Three beautiful exhibits illustrate the use of wool in manufacture, the mechanical processes being shown from the unwashed wool to the complete fabric. The first of these, contributed by the Arlington Mills, Lawrence, Massachusetts, illustrates the manufacture of dress goods; the second from the Middlesex Mills, Lowell, Massachusetts, is an exhibit of yacht-cloth manufacture, and the third, of the manufacture of bunting for flags, donated by the United States Bunting Company, of Lowell, Massachusetts.

THE COTTON SERIES.

The series of cotton exhibits in the fiber section of the collections of the agricultural products of the United States, embraces about 150 specimens, illustrating cotton production on the farm, by means of specimens of plants as ready for the

BRINGING COTTON TO MARKET.

TRANSPORTATION OF COTTON ON MISSISSIPPI STEAMER.

A MISSISSIPPI COTTON-PRESS.

A COTTON-GIN (MISSISSIPPI).

pickers, and of a full collection of the principal varieties of seed cotton, as picked and ready for the gin; the commercial side of the cotton industry, illustrated by examples of the cleaned cotton or "lint," as well as an officially classified series of the trade grades; and, lastly, cotton manufacture, to a limited extent, including the products of cotton seed and of cotton-seed oil.

While the cotton series is complete and interesting, it is to be regretted that the work of collection could not have been begun earlier, almost the entire series having been secured and prepared in the two months ending February 16, 1889. With an earlier beginning a more complete and valuable collection of lint cotton could have been secured, and undoubtedly a higher grade of samples of cotton in seed would have been received, many of those sent having been gathered after the crop for the most part had been picked and sold.

Reference should be made to an accompanying series of ten enlargements of photographs illustrating different places of cotton culture and the disposition of the crop, as the field, the gin house, the compress, modes of river and land transportation to market, the implements employed in the culture, etc. (Some of these are reproduced on Plates XLVIII–LI.)

COTTON IN SEED.

Between sixty and seventy varieties of cotton grown in the Southern States are shown in this series, chiefly donated by correspondents of the statistical division of the United States Department of Agriculture and grown by them, or by their neighbors.

While many of the samples are very good, owing to the fact that the call for specimens was not made until very late in the season, after the crop was partially gathered and for the most part disposed of, they are not in every case fully representative. In the department series there are fifty varieties of specimens, as follows:

1. Allen's Long Staple.
2. Common Cluster.
3. Jones Improved.
4. Clark's Prolific.
5. Hickory Nut.
6. Collier.
7. Ozier Silk.
8. Tyronza.
9. Hybrid Prolific.
10. Myers.
11. Odom Prolific.
12. Green Seed Cluster.
13. Java.
14. Improved Lamar.
15. Moonshine.
16. Ounce Boll.
17. Big Boll Prolific.
18. Improved Dickson.
19. Dewalt.
20. Dewalt.
21. Hybrid Prolific.
22. Thompson Big Boll.
23. Beat All.
24. Hickory Nut.
25. Simpson's Early.
26. Farris.
27. Black Seed.
28. Storm Proof.
29. Green Seed and Ounce Boll Mixed.
30. Matagorda Silk.
31. Peerless.
32. ——— ———.
33. Worlds' Wonder.
34. Peterkin.
35. Sugar Loaf.
36. Hord's Hybrid.
37. Yeawoods Texas.
38. Rouse Improved.
39. Tomlin Storm Proof.
40. Ozier Silk.
41. Big Boll.
42. Angola Cotton.
43. Seller's Silk.
44. Truitt's Improved Premium Prolific.
45. Truitt's Improved Premium Prolific.
46. Duncan.
47. Guy's Improved.
48. Silk.
49. Little Deveraux Bays.
50. Allen's Long Staple.

A second collection of small samples was obtained by Mr. James R. Binford, from the Louisiana experiment station at Baton Rouge, which contains nearly a score of varieties not found in the series furnished by the Department corps correspondents. The list is as follows:

1. Southern Hope.
2. Bancroft's Herlong.
3. Peeler.
4. Petit Gulf.
5. Allen's Long Staple.
6. Tennessee Silk.
7. Boyd's Prolific.
8. Peterkin.
9. Crawford.
10. Hawkins.
11. Peerless.
12. Zelnero.
13. Dickson.
14. Jeff. Welborn's Pet.
15. Cherry's Cluster.
16. King's Improved.
17. Hawkins D.
18. Peterkin Home.
19. Oats Cotton.
20. Sea Island D.
21. Sea Island.
22. Little Brannon.
23. Allen's Long Staple.
24. Boyd's Prolific.
25. Peterkin.
26. Tennessee Silk.
27. Martin's Prolific.
28. Herlong.
29. Jones's Improved.
30. Jower's.
31. S. B. Maxey.
32. Cherry's Long Staple.
33. Shine's Early.
34. Jower's Improved.
35. Same as 32.
36. Same as 31.
37. Same as 33.
38. Griffin's Improved.
39. Taylor's Improved.
40. Bancroft's Extra Herlong.

Of these Peterkin, Hawkin's Improved, Jeff. Welborn's Pet, Cherry's Cluster, Jones's Improved, Shine's Early, Taylor's Improved, Jower's Improved, and S. B. Maxey were distributed by the United States Department of Agriculture.

HISTORY OF AMERICAN COTTONS.

An effort was made to learn something of the history of the principal varieties of cotton grown in the United States, with the prime object of stating origin and giving descriptions of peculiarities by which they are known. The effort was only partially successful, owing to lack of time, though a considerable amount of interesting matter was gotten together relating to these specimens, from which a few brief statements have been condensed.

The descriptive list of varieties is as follows:

Allen Silk or *Allen Long Staple.*—This variety is said to have originated in Mississippi, in the Delta section, from a large seeded upland variety. It is described as long limbed, large bolled, of fine long staple, and prolific. Yields 30 pounds of lint to 100 pounds of seed, and the finest of it commands from 1 to 2 cents more per pound than ordinary cotton. A correspondent in South Carolina states that when ginned on the McCarthy long staple gin it brings 50 per cent more sold in the Liverpool market than the ordinary upland cotton. It matures later than most varieties by two weeks; it is a great favorite. From its length of staple this cotton is a favorite with manufacturers who employ Sea Island largely in their manufactures.

Common Cluster.—Originally known as Burr Cotton, from its clustering disposition, after the manner of the sheep burr. Selected, cultured, and improved to great perfection by David Dickson, of Sparta, Georgia. All the clustered varieties, and there are many, with different names and slightly different characteristics, are of this stock. Limbs short and few, large proportion of fruit on stalk maturing too nearly together, harder to save without waste, and liable to greater loss from

drought in time of bearing. The proportion of lint to seed is 29 to 30 per cent. A Mississippi correspondent writes that it is very productive, as it can be planted closely in rows, and grows without branching much, the bolls growing very close together; it does best in rich soils and in rainy sections, as it is prone to shed in very dry weather.

Jones's Improved.—The seed of this variety was distributed by the Department in 1886, very favorable reports having been received from it. It was produced at the rate of 1,200 pounds per acre in Mississippi. It was produced by J. F. Jones, at Farm Independence, near Hogansville, Troup County, Georgia, and may be described as one of the large-bolled varieties; it is easily picked, though some report that it does not stand storms well. A North Carolina correspondent considers it a choice variety for sandy lands, and says that it holds its form when other kinds fall.

Clark's Prolific.—A variety of medium staple, uniform length, and of great strength. It yields a large per cent of lint. It is used chiefly in the manufacture of spool thread. Originated on James Island, South Carolina. One of the many selections made by the late Ephriam M. Clark, of James Island. This sample was received from Florida.

Hickory Nut.—This is another variety in favor with spool-thread manufacturers, from its uniform length of staple and great strength. Six bales have been produced from 7 acres, and 1,300 pounds of cotton in seed has ginned 500 pounds of lint. It originated near Beaufort, South Carolina.

Collier.—A long staple variety, said to have been produced in Hunt County, Texas.

Ozier Silk.—Probably originated in Corinth, Mississippi. In length of staple it is above the average; growth medium and yields well. It seems to be a hybrid between the cluster and lint varieties. An Arkansas correspondent writes that it commands the best price in the St. Louis market of any variety he produces, on account of its fineness and length of staple.

The Improved Ozier Silk is an improvement on the above, from careful selection by F. A. Howell, of Durant, Mississippi, who contributes the specimen exhibited. It has long limbs, fruits well, and yields well, the lint being longer and stronger than the average upland.

Tyronza.—One sample was secured from S. A. Martin, of Crittenden County, Arkansas, who states that the variety has been grown along the Tyronza River, in that State, for twenty-five years. The sample was grown on land that has been planted with this variety for ten years consecutively. The yield, season of 1888, was 750 pounds of lint, or 2,250 pounds in seed per acre.

Hybrid Prolific.—The history of this variety can not be given. The sample was received from Brazos County, Texas, where it is popular. Said to be very prolific, five locks to the boll, easy to pick, with no waste in the field from wind or rain. Yields a high per cent of lint to seed.

Myers.—Sample also received from Texas. It is a large-bolled, five-lock cotton, very prolific, said to stand drought well, and gives about 34 pounds of lint to 100 in seed. Stands the weather well in the field.

Odom Prolific.—Specimen received from S. P. Odom, of Dayton, Georgia, who states that the variety is an improvement upon the Ozier Silk and the Dickson. It is an early variety and very prolific, the donor having made, in the season of 1888, 3 bales of 506 pounds lint each to the acre, on common land which had been well fertilized.

Green Seed.—This is one of the old varieties, yet preferred by some planters to the improved kinds, as it opens sooner and is thought to hold longer without falling out. Sometimes called the Green Seed Cluster, giving five locks to the boll; it is well limbed and fruitful.

Java.—This sample was received from Tennessee, where it is said to mature well on any land, opens finely, and is easy to pick.

Moonshine is another variety from Tennessee, of which I can give no information. It is a long staple cotton with fine lint.

Improved Dickson.—One of the standard old varieties from selections made by David Dickson, of Sparta, Georgia. The bolls are of good size, seed rather large but well set with lint, the yield being usually large. It is not strictly a "Cluster" cotton, as the stalk is of medium size, the limbs and joints rather short. Was one of the popular varieties some years ago.

Finch's Selection is a variety selected from Dickson by J. L. Finch, of Stanhope, North Carolina.

Ounce Boll.—This is a great favorite in Tennessee, said to be one of the best kinds grown in this section of the cotton area. It takes its name from the large size of the bolls. It holds well and is easily gathered. Samples of Ounce Boll and Green Seed mixed were also received. The two varieties mix so freely that it is difficult to find a pure example of the former. Its origin can not be given.

Big Boll or *Big Boll Prolific* (also known as Bahama).—Fine lint, large boll, making it an easy variety to pick. It fruits well, and will yield on good land 2 bales of 500 pounds each to the acre. Does not do well on wet land, however. Seed of this variety was distributed by the Department of Agriculture some ten years ago.

Thompson Big Boll.—A large-bolled cotton selected by Mr. Thompson, of Drew County, Arkansas. Picks well and yields well. The correspondent sending it says: "It stands almost everything and is hard to beat. We plant nothing else."

Dewalt.—Mr. W. B. Dewalt, of Reagan, Texas, says of this cotton: "It is an improvement on the Sue Poe long staple, and is very prolific. Five locks to the boll, and is considered storm proof, holding well in the field. To-day, December 29, 1888, an average hand can gather 200 pounds per day."

Simpson or *Simpson's Early.*—Although this variety was distributed by the Department of Agriculture a few years ago, I can find nothing regarding its history. It is said to yield well.

Black Seed.—Sample from Prairie County, Arkansas. The donor says of it: "Taken from the public gin on account of small seed and good lint."

Storm Proof.—A popular Texas variety, large bushy stalks, dark-green foliage, and large round boll, not so thickly set as many other varieties. It is a little later in opening than most varieties. Staple fairly long and strong, seed large. Its chief merit, however, is that it holds in the boll after opening and is not beaten out by rain storms or bad weather, and can therefore be saved in good condition late in the season. There are several improved selections of Storm Proof, as the Lamar, improved by G. M. McDaniel, of Hill County, Texas; the Farris, which the donor claims "is one of the best cottons." It has a low stalk, but branches well and is exceedingly hardy. Five locks to boll; gins well, though it produces a large quantity of seed. The Tomlin Storm Proof was sent by M. R. Tomlin, of Crenshaw County, Alabama, who selected it from a hybrid long staple and Herlong.

Silk and *Matagorda silk.*—Several varieties of "silk" cottons were received from Missouri and Arkansas. I am not able to give any information concerning them.

Peerless.—A popular variety, especially for cultivating on rich land. Branches low, from two to four arms springing out from the main stalk. Very prolific, one of these branches often producing as much cotton as a single stalk of common varieties. Sometimes bears so heavily that these main branches become broken. Though the bolls are produced very thickly, it is not a cluster cotton. A correspondent in Alabama writes: "I am satisfied that on well-prepared, well-manured, and well-cultivated land more and better cotton can be raised of this variety than any I have ever seen."

Maynard's Improved Peerless.—Improved by William I. Maynard, Forsyth, Georgia. Very prolific. Has extra limbs and is full fruited; extra lateral growths which also produce fruit. The originator says: "Sometimes a dozen bolls may be seen on a branch not exceeding a foot in length."

Peterkin.—One of the most popular varieties of cotton grown, judging from specimens received. Improved by J. A. Peterkin, Fort Motte, South Carolina. Fine staple, large bolls, small seeds, easy to gather, prolific, open growing; will stand dry weather better than other varieties, and holds fruit well. The originator claims that 40 per cent of lint net is yielded. In the South Carolina Experiment Station table the percentage is given at 37.50, which is considerably higher than any other sample of the forty-four that were stated. A Tennessee correspondent sends a fine specimen and states that 1,300 pounds of cotton in seed will yield a 500-pound bale. The seed is very small, almost clear when ginned, and is jet black. The writer says that it is a little later in growing off in spring, and also in opening, but opens freely and full. The best sample shown in the exhibit is from Hamilton, Georgia, the donor of which says: "Peterkin makes the finest staple, almost equal to Sea Island or Silk, and yields more lint from the cotton in seed than any other variety; 1,200 pounds in seed has yielded 500 pounds of lint."

James Brown, of Martin, South Carolina, thus writes of it:

"Longer limbed than other varieties which are more evenly and regularly dispersed on stalk. Fruit distributed all over the plant and maturing gradually. Great advantage in unpropitious seasons. Can have more distance between plants than other kinds. Seed very small. Thirty-seven to thirty-eight per cent of lint to seed is an average, which is more than of any other variety. Brought to this county from Texas in 1838 or 1840, then called Rio Grande. Selected and improved to present condition and variety by J. A. Peterkin, of Fort Motte, South Carolina."

It is grown from South California to Texas and Arkansas, and is universally considered to be one of the most prolific varieties planted.

Sellers' Silk.—Sample sent by Dr. J. R. Sellers, of Fayette County, Tennessee who says:

"This cotton is noted for its fine lint. I have improved it for seven years. It will yield from 1,000 to 1,600 pounds of seed cotton to the acre on good land. It stands wind and rain well, and fruits well."

Guy's Improved.—Cross between Allen's Long Staple and Duncan's Mammoth Prolific. Vigorous stalk, foliage small, seed medium, lint long and silky.

Truitt's Improved.—An improved variety from careful selections by George W. Truitt, La Grange, Georgia. Two fine samples of this cotton appear in the Department exhibit. Dr. H. H. Cary, superintendent of fisheries, La Grange, Georgia, thus writes of it:

"This variety has been brought to its very high state of excellence by originally planting the best varieties in patches, careful selection made of best specimens from such patches, and plantings made for a series of years, resulting as follows: The first year a thousand pounds of seed cotton to the acre, from three to five locks to the boll, taking 100 bolls to make one seed cotton. The last gathering in 1888 showed six to eleven locks to the boll, and 4,500 pounds of seed cotton to the acre. The size of the bolls has also been increased. Thorough preparation and cultivation of the soil, and heavy but not costly fertilization, has tended largely to wards such wonderful results."

Duncan.—Origin can not be stated. Yield said to be a very prolific long staple; holds well in the field, and sells well in the market.

Mikado.—No information can be given regarding this variety, one fine sample of which was received from Houston County, Georgia. It is claimed to be very close-bolled, very vigorous, early maturing, and stands dry weather better than many other varieties.

Heubner's Improved.—One sample was received from Texas. A large-bolled variety, of long staple, holds well in the field, and stands dry weather better than many other varieties.

Hawkins' Improved.—Early, prolific, easy to pick, fine staple, grown tall, with

long tap-root, resisting drouth, from two to four limbs near the surface, Large bolls, seed small, light gray or dark gray or dark green, opens well, and yields a high percentage of lint to cotton in seed. Variety originated by B. W. Hawkins, Nona, Putnam County, Georgia, and is a cross between the New Era and the Prolific.

Cherry's Cluster.—A long staple variety improved by Mr. C. S. Cherry, Bethel, North Carolina. It was experimented with by the Department of Agriculture some years ago and was favorably reported upon.

S. B. Maxey.—A Texas variety, also distributed by the Department. It produces medium bolls, small seeds, fine staple, yields well. Has produced in Mississippi 1,800 pounds per acre. It stands drouth better than most varieties. It is long limbed, and fruits closely. Said to yield a high percentage of lint cotton in seed.

Probably twenty others are shown in the exhibit, but as some of them are little known outside of the locality where originated, and the origin of others not known, no special mention of them is necessary. At the same time, doubtless, some of the varieties that have been named are of slight value as varieties, being little, if any, improvement over well-known kinds from which they have been selected.

LINT COTTON.

The third exhibit in the cotton series, embracing some thirty varieties of lint of ginned cotton, was chiefly made up from the extensive collection of the Department of Agriculture, secured by the writer in 1876 for the United States Government exhibit at the Centennial Exposition in Philadelphia. The larger part of this exhibit, therefore, comprises the old varieties that were popular from twelve to twenty years ago. Such are the Egyptian, Goosey, Tumel Maki, Moina, etc. Three specimens are interesting as having been grown in the Indian Territory. The last five numbers in the series, however, are presented as typical specimens of Sea Island and highest improved upland cottons. No. 74, named "Constellation," a bale of which is also placed on exhibition, was presented by Mr. Washington A. Clark, of Columbia, South Carolina, and was grown on James Island, where his father, the late Ephraim M. Clark, experimented so long and so successfully in improving Sea Island cotton. The following letter from Mr. Clark, giving the history of Sea Island cotton, and also of the superior sample of the same under consideration, is so interesting that it is produced entire.

COLUMBIA, SOUTH CAROLINA, *March* 16, 1889.

Mr. CHARLES RICHARDS DODGE,
Special Agent, Department of Agriculture, Washington, D. C.:

DEAR SIR: Replying to your favor of the 14th instant, I beg to say: It is known that the first bale of long staple cotton exported from America, in 1788, was grown on St. Simons Island, Georgia; that this bale was grown by a Mr. Bissell from seed that came from either the Bahama or the Barbados islands.

Singularly enough, the authorities leave this matter in doubt, the Hon. William Elliott saying it came from Anguilla, one of the Bahamas, and Signor Filippo Partatori (Florence, 1866) saying it came from Cat Island, one of the Barbados. But as Anguilla is one of the Barbados and Cat Island one of the Bahamas, it would seem difficult to decide to which group of islands we are indebted for this seed. However, as Mr. Thomas Spalding, of Sapelo Island, says in a letter to Governor Seabrook, in 1844, that three parcels of long staple cotton seed were brought to a gentleman in Georgia from the Bahamas in 1785 and 1786, it would seem that the seed reached our coast from these islands.

In the Bahamas it was called *Gossypium barbadense*, in consequence, doubtless, of being brought from Barbados. In the latter island it was known as Persian cotton (Edwards's West Indies, Vol. IV, page 363), and was thought to have come

from that country, where it was originally derived from the *Gossypium arboreum* of India. Be this as it may, Mrs. Kinsey Burden, of Burden's Island, Colleton County, South Carolina, obtained some of these seeds from Georgia and planted them. This crop failed to mature, and the first successsul crop of long staple cotton grown in South Carolina was planted in 1790, by William Elliott, on the northwest corner of Hilton Head, on the exact spot where Jean Ribault landed the first colonists and erected a column of stone, claiming the territory for France, a century before the English settled on the coast. Mr. Elliott's crop sold for tenpence halfpenny per pound. Other planters made use of this seed, but it was not until Kinsey Burden, sr., of Colleton County, began his selection of seeds, about the year 1805, that attention was strongly called to the the long staple. Mr. Burden sold his crop of that year for 25 cents more per pound than did any of his neighbors. He continued to make selections of seed and to improve his staple, and in 1825 he sold a crop of sixty bales for $1.16 per pound. The subsequent year his crop sold for $1.25, and in 1828 he sold two bales of extra fine cotton for $2 per pound, a price not often exceeded since.

"The legislature was on the point of offering Mr. Burden $200,000 for his method of improving the staple of cotton, and Mr. William Seabrook of Edisto was prepared to pay him $50,000 for his secret when it was discovered that the fine cotton was due wholly to improvements made in the seed by careful and skillful selections. Since then the greatest care has been bestowed upon the selections of the seed, and to such perfection was the staple brought by this means that the crops of some planters were sold not by sample, but by the brand on the bale, as the finest wines are. During the war, the cultivation of the finest varieties being abandoned on the islands, the seed removed to the interior was greatly depreciated in quality. So scarce on this account was good seed directly after the war that I. T. Dill, a cotton merchant in Charleston, at one time had in an ordinary little envelope the seed from which all the better qualities of long staple cultivated now was derived. Nor have the improvements made by careful selection of the seed ceased in later years. The staple has kept up fully to the best grades of former days and the proportion of lint to seed cotton has been increased. Formerly 1 pound of lint cotton from 5 pounds of seed cotton was considered satisfactory. Thanks to the efforts of Mr. E. M. Clark a fine variety of cotton has been recently found which yields 1 pound of lint to 3½ pounds of seed cotton, preserving at the same time the strength, length, and evenness of fiber characteristics of the best varieties." (South Carolina, published by the State board of agriculture of South Carolina. 1883, page 27.)

This extract from the handbook of South Carolina gives the most accurate account of the sea-island cotton as grown and developed on our sea islands. "Much of the cotton now grown along the Atlantic coast from South Carolina to Florida is of some one of the selections made by my father, the late Ephriam M. Clark, of James Island, South Carolina. In order to place the product sold under his brand beyond the competition of others, my father selected for his own use a variety of cotton of which you have a sample, under the brand "Constellation," which is now planted exclusively by me. This cotton yields 1 pound of lint to 4 pounds of seed cotton, and is much finer in fiber and larger in staple than any other cotton planted, and fetches upon the market about 50 per cent more than the coarser varieties of his selections. The sample sent from Mr. Hinson is also grown from one of his selections, made exclusively for Mr. Hinson. It is a finer variety than that grown by other parties. and ranks, I suppose, next to the Constellation.

Trusting that I have been able to serve you, I am dear sir,

Yours, very respectfully,

W. A. CLARK.

The sample referred to in the last paragraph of the letter is No. 75 of the cotton series, and is a superb specimen of improved sea island contributed as a compari-

son bale to Mr. Clark's by Mr. William G. Hinson of James Island. A fine sample of Peterkin cotton (No. 76) and an equally fine specimen of the S. B. Maxey (No. 78) are shown as examples of improved upland lint cotton.

In connection with the foregoing exhibits of seed cotton and lint, it will be well to refer at this point to the beautiful and illustrative series of 44 specimens of cotton-seed arranged under glass against a black background, showing size of seed and length of staple. The samples were taken from the varieties grown on the experiment farm of South Carolina University in 1887, and were prepared for the Agricultural Exhibit of the United States in Paris, by Prof. Loughridge of the University. A table of the varieties shown, as well as the percentage of lint to seed cotton for each, is herewith presented:

Variety.	Per cent of lint.	Variety.	Per cent of lint.
Crossland	34.50	Southern Hope	37.00
Jeff. Welborn's Pet	32.25	Drought Proof	31.50
Herlong	31.50	Allen's Silk	30.50
Sea Island, from Upland:		Maxcey's Texas	30.50
Dickson's Cluster	31.50	Dearing	32.00
Griffin's Improved	32.00	Bahama	32.75
Jones's Improved	32.50	Duncan's Mammoth	31.75
Taylor	32.25	Sea Island from coast	25.00
Peterkin	37.50	Hawkins	31.50
Richardson	31.50	New Texas	31.50
Thómas	32.25	Mammoth Cluster	32.75
Cherry's Long Staple	32.78	Six Oaks	28.50
Cobweb	30.75	Peerless	30.25
Dickson's Improved	32.50	Mexican Burr	31.00
Ozier Silk	31.50	Jower's Improved	32.80
Williamson	32.00	Simpson	31.75
Jones's Long Staple	31.75	McCall Improved	32.75
Eureka	30.75	Shine's Early Prolific	30.50
Truitt	32.75	Hays China	31.75
Texas Strom Proof	32.00	Excelsior	31.75
Texas (Miles) Wood	38.00	Meyer's Texas	32.00
Crawford's Peerless	32.00	Minters	32.75

Three collections of cotton seed are shown in the cotton series containing samples of 20 varieties from the Alexander Drug and Seed Company, of Augusta, Georgia, from J. R. Binford, Duck Hill, Mississippi, and from the Museum of the United States Department of Agriculture. This exhibit embraces the leading varieties, such as Allen's Long Staple, Peterkin, Herlong, and other well-known varieties. While the samples are interesting in themselves as illustrating the variation in size, form, and color of different varieties of cotton, they are also interesting as a whole from the fact that in recent years several large industries have sprung up into existence which use cotton seed entirely in their manufacture. Cotton-seed oil and cotton-seed oil products, however, will be treated more fully in their appropriate place, a few pages further on.

COTTON MANUFACTURE.

In this portion of the cotton exhibition it is not proposed to illustrate simply the manufactures of cotton, but, beginning where we left off, with the product of the gin—that is, with cleaned lint—to show the principal processes that raw cotton goes through in course of manufacture, leading up to the finished product and there leaving it, with examples illustrating a few of the principal uses.

The seventh exhibit in the cotton exhibit is a case 14 by 2 feet and 10 incehs deep, divided into 25 compartments, in each of which is admirably shown one of the many processes through which sea-island or long-staple cotton goes, in its conversion into a spool of thread. This was prepared under the direction of Mr. E. S. Boss, agent of the Willimantic Linen Company, of Connecticut, and by the company presented to the exhibit of agricultural products of the United States. The series covers 25 processes and exhibits.

Similar exhibits were received from Mr. Robert Redford, agent of the Arlington Mills, Lawrence, Massachusetts, illustrating the manufacture of yarns, which enter into many other industries, as the manufacture of cotton plush goods, cotton wrapping for electrical wire, and other uses where superior cotton is employed; from Mr. W. F. Sherman, agent of the Atlantic Mills, series illustrating the manufacture of cotton sheeting and white goods, with one sample of sheeting warranted to measure two and a half yards wide when bleached; samples of "Odenheimer cotton bagging" and twine from the Lane Mills, New Orleans, La.

Regarding the manufacture of cotton bagging in the South, it is claimed to have been brought about through the high price put upon jute bagging by the bagging trust of New York. A low grade of cotton is employed, but notwithstanding, a fine bagging is produced, almost too good for the purpose, when compared with jute. The bagging can be produced in any cotton mill, and in large quantities and in the heart of the cotton country. A low grade of cotton is employed that hitherto has been hard to sell at any price. The cotton bagging is as elastic as jute, fully as strong, and as well adapted to covering cotton. It will stand hooks, rough handling, and compressing, while it is claimed that it will protect the cotton better from dirt and water, and afford better ventilation. It is also claimed that it can be produced as cheaply as the jute bagging, and actually cheaper when considered that the cotton bagging can be used a second time.

A valuable set of samples of raw cotton, commercially graded, was obtained by purchase from the Cotton Exchange of New Orleans. These comprise nine samples in each grade, exhibited in walnut, glass-covered cases about 20 inches square, under the official seal of the Exchange. The grades, though perfectly familiar to the trade, are nevertheless stated here for the information of the general reader. They are: Low ordinary, ordinary, good ordinary, low middling, middling, good middling, middling fair, and fair.

An interesting specimen relating to the cotton series, though exhibited in another subsection of the fiber exhibit, is the prepared fiber from the bark of the cotton stalk. It will be fully treated, however, with the best fibers in another portion of this report.

COTTON-SEED OIL AND COTTON-OIL PRODUCTS.

In a report on vegetable fibers prepared by the writer, and published ten years ago, occurs this statement:

"For every bale of cotton there is nearly half a ton of seed, and nearly 2,000,000 tons of seed are now wasted, for its partial use as a fertilizer is little better than waste, in view of the fact that 20,000,000 sheep might be fed with the utilized seed, and the inexpensive green-feeding that would be required to supplement it."

Cotton-seed oil has been known for some time, although it is only in the last decade that this industry or the series of industries growing out of it have been so largely developed, as at the present time, utilizing as they do the greater portion of this former "waste product" and giving employment to hundreds, or rather thousands, of people both in the North and South.

Less than ten years ago, it is claimed, only a seventh of the available cotton seed of the United States was milled for oil, while during the year just passed, with a larger crop, it is estimated that more than two-thirds of the available seed was used. That the refining of cotton-seed oil has reached a high state of development is proved by the fact that considerable quantities of it enter into the trade as olive oil. Not many years ago the exports of cotton-seed oil to Italy were quite large, the product being returned to us under the familiar label "Huile d'olive." And when the imports into Italy of cotton oil were prohibited, the exports of olive oil to this country fell off in the same ratio. But cotton oil, properly refined, is wholesome and good. It is the fraud, and not the oil, which is to be condemned.

For many years the product under its own name has been used in the domestic economy, many people considering it nicer and more healthful than hog lard in the preparation of food, that preparation of food that must be cooked in hot fats. As oil is not as convenient to use as lard, a new product has been put upon the market known as cotton-oil lard, and which the manufacturers, The Cotton Oil Product Company, of New York City, guarantee contains no other ingredient than pure oil of the cotton seed and a small quantity of the highest grade of choice beef fat. It is said to be "conducive to health, being perfectly pure, clean, and wholesome. Medical authorities state that, unlike hog lard, it is an anti-dyspeptic, in fact an aid to digestion. For all cooking purposes and for making pastry, it will be found greatly superior to hog lard. Its richness and purity obviate the necessity for the addition of butter, when using it, and the economy resulting from its use will be found a very considerable item, as it requires a considerable less quantity to produce the results obtained by the use of hog lard."

In my experience cotton-oil lard has been found palatable and good, the kinds of cookery requiring the use of considerable lard, and hence, as a rule, very greasy, being made more delicate by its use.

In addition to the lard there is a full series of crude and refined oils from cotton seed, the latter representing winter and summer strain, both white and yellow oils having been presented by the Southern Cotton Oil Company of New York. A highly refined sample, contributed from another source, is exhibited as the grade oil which sometimes masquerades under the name "Huile d'Olive."

The cotton-oil series is made complete by specimens of soap and washing powder, in variety, manufactured from cotton oil, and presented by the Cotton Oil Product Company of New York, under the name of "Copco," soaps, etc.

Herewith is presented a general report of the history of cotton culture in the South, made by Mr. James R. Binford, of Duck Hill, Miss., special agent in the division of cotton and fibers.

REPORT OF MR. JAMES R. BINFORD.

Although comparatively of recent introduction here, the cotton plant was known in the earliest ages in the Old World. Herodotus describes the plant as "producing in the Indies a wool of finer and better quality than that of sheep." Pliny mentions certain wool-bearing trees which were known in Upper Egypt, bearing a fruit like a gourd, of the size of a quince, which, bursting when ripe, displays a ball of downy wool from which are made costly garments resembling linen. At the commencement of the Christian era it had become an article of commerce in the ports of the Red Sea, and the remote parts of India had at that early period acquired a celebrity for cotton fabrics. The name cotton is said to be from the Italian cotone, because it resembles the down of the quince, termed by the Italians catogini. Many varieties of the plant are described by different writers, and among them the perennial or tree cottons, which grows spontaneously in Brazil and Peru. I shall, however, confine myself to the herbaceous variety cultivated in the United States.

The average height of the plant in land of medium quality is about 5 feet, although in very fertile soil it attains to double that height, whilst in sterile or exhausted lands it becomes quite a dwarf. Its appearance is very similar to that of the okra plant, but it is much more branched, the leaves smaller and of more uniform shape. The branches are long and jointed, and bearing at each joint one or more bolls or capsules, containing the fiber and seed. The woody fiber of the plant is white, spongy, and brittle, but is covered with a thick, brown epidermis, which is very pliant and tenacious. The root is tuberous, penetrating deeply into the subsoil. The blossom or bloom is cup-shaped, 2 or 3 inches in length, being very widely expanded, white on the first day until past noon, then changing gradually

for the next two or three days, with a twist at the extremity over the germ of the young boll, by which it is specially detached in its rapid growth, when it withers and is cast off, leaving the boll by a capacious tripartite calyx, sufficiently large to inclose it until half grown. The calyx containing the germ of the bloom is triangular in shape and is technically known as the square, or form. In this stage of the growth these are liable to become disconnected from the long prevalence of drought, but perhaps more so when a rainy season suddenly succeeds, occasioning a second growth from the rapid elaboration of sap, which in its circulation does not enter into the footstalk so freely as into the other parts of the plant. The cotton plant begins to bloom about the 1st of June and continues until the frost kills it. The time, however, both as to blooming and ceasing to bloom, is dependent upon the latitude in which the plant is grown, as farther south the seasons are earlier and the frost later, and consequently the blooming would be earlier and continue longer. The bolls are egg-shaped, but under the size of the egg of the domestic fowl, pointed at the extremity, expanding widely when fully matured, exhibiting a brown, tough, woody membranous seed vessel, somewhat horny in texture, to which the expanded locks of fiber or lint adhere.

Cotton was doubtless indigenous to America, having been found growing wild in Hispaniola and other West India Islands when discovered by Columbus, and at the period of the conquest of Mexico by Cortez the natives made "large webs as delicate and as fine as those of Holland." Their cotton fabrics were varied and beautiful, and constituted their chief article of dress. As to the exact time it began first to be cultivated and utilized as an article of commerce in the United States there is some doubt, yet as early as 1719 we find that it was suggested that the climate of South Carolina was favorable for its production, and the first provincial congress of that State in 1775 recommended to its people to raise cotton. I think, however, that Georgia took the lead in its cultivation, and the first shipment of cotton of which there is record was in 1784, when eight bags were seized by the custom-house officers at Liverpool, upon the ground that even the small quantity of 2,900 pounds had not been raised in the United States.

Whilst it is true that Georgia took the lead in the cultivation of cotton, we find that nearly forty years prior to that time cotton was raised farther south, or rather in Louisiana and along the Mississippi River, for Charlevoix, on his visit to Natchez in 1722 mentions the cotton plant as growing in the garden of Sieur Le Noir, the company's clerk, and Bienville, in one of his dispatches dated in April, 1735, says the cultivation of cotton proved advantageous. It is stated by Meyer Stoddard to have been cultivated by the French colony in 1840, and Judge Martin quotes from a dispatch of Governor Vandrenil of 1746 to the French minister, in which he mentions cotton among the articles received by boats which came down annually from Illinois to New Orleans.

Since the cultivation of cotton began many varieties of seed have been tried, and by the intermixing of the pollen many new and excellent varieties have been produced, which have been preserved and further improved by a careful and judicious selection of seed from the most thrifty and prolific stalks in the field, and now annually we hear of new varieties of seed being introduced, the owner always claiming superior yield or superior staple ; and the cotton planter, always anxious to get the best seed, is often made the dupe of some shrewd speculation and is more damaged than benefited. Cotton is probably more subject to diseases than any other plant, the principal ones of which are the rust, the rot, the sore shin, and the blight, and if it fortunately escapes these it is often attacked by either the boll worm or army worm, or both. The rust is probably attributale to some mineral properties of the soil, as it is local and is partial in its effects, and in the spot of ground affected by it the difference in the soil is often obvious to the eye. The appearance of the plant so diseased suggests the existence of microscopic fungi, which exhaust by their par-

asitic growth the sap of the leaves and cause them to wither and fall. The rot or disease of the boll has been assigned to various causes. The disease commonly known as the sore shin attacks the plant in its early stage. If not wholly destroyed the bark of the plant becomes diseased and hardened, and the sap vessels dried up or obstructed at or near the surface of the ground. The growth of the young plant is thus made slow and languid, and although the damaged epidermis may be overgrown by another bark it is questionable whether the plant ever becomes as vigorous and prolific as those that have not thus been injured. This disease is not prevalent during the occurrence of cold nights of a late and wet spring, and this cause also produces what is commonly called the Cotton Louse (*Aphis gossypii*), which attacks both stem and leaf and causes it to present a parched appearance. These causes (sore shin and lice) often destroy the strands of cotton, or so injure them that the planter is compelled to plant the second time. Should the young plant be so fortunate as to escape the above-named diseases and arrive at a stage of maturity, it is frequently attacked by either the Cotton Worm or Boll Worm, and often by both; the former attacking and destroying the foliage and the latter the bolls. The degree of damage done by the caterpillar depends upon the period it commences its depredation; if so early that but few bolls are matured, the plant must cease to grow when thoroughly stripped of its leaves, and this is generally about the time they make their most vigorous attack; but it sometimes occurs, but very rarely, when the growth of the plant was too vigorous and continued too late in the season partial cropping of the leaves by the worms has a beneficial effect in arresting the growth and causing the bolls to mature and open.

The Boll Worm within the calyx is square and about the base of the boll, which it perforates when first forming and tender, causing it to drop off, or, if more mature, to become hard and woody, so that it is utterly destroyed. These small worms do their work so secretly and rapidly that unless the planter makes close examination his crop is often seriously damaged when he would think from all outward appearance he has a very flattering prospect. Various remedies have been suggested and tried to destroy these two enemies of the cotton crop, but as yet none very effective; but within the past few years a solution of Paris green sprinkled over the cotton plants has to some extent proved a success in killing the caterpillar, yet even this partial success is attended with much trouble and expense, and oftentimes even damage to the plant.

There must always be some diversity of practice in the details of all agricultural operations. The character and situation of the land, the nature of the soil, the varieties of the season will influence these more or less. The following mode of cultivation, therefore, relating to the cotton plant must be received as descriptive of the general practice pursued by planters:

First, as to the preparation of the land. Early in the spring what is known as a center furrow is made and upon this two furrows are lapped; in this state it remains until all the ground has been gone over, when from two to four more furrows are thrown to these, thus forming a ridge or bed upon which the seed is sown. The distance between the rows differs according to the fertility of the soil, ranging from 4 to 6 feet. In planting, as in everything else connected with the cotton production, great improvements have been made. In the early days of cotton cultivation the seed was planted exclusively by hand, now it is mostly done by the planter; where it formerly took one plow, horse, and man to open the ground for the seed, another to sow them, and a third to cover with a plow or harrow, now all is done by one man with a cotton-planter which opens the furrow, sows the seed more regularly than it could be done by hand, and covers it. When the cotton has come up and grown to the height of a few inches in a week or ten days it begins to require thinning out and scraping. This was formerly done almost entirely by the hoe. It is now done by running what is known as a scraper lightly on each side of the row or

close to the young plant, which leaves it in a good condition to be easily blocked out or thinned to a stand by the hoe. And here I will remark that several revolving hoes have been invented to run by horse power to do this thinning, but as yet none of them have proven a success, or at least only partially so. After having chopped the cotton to a stand, the plows come again as soon as possible, throwing the dirt back to the plant, which process is called dirting or molding cotton. This is usually done with either a shovel, plow, or sweep. Here, again, is a great improvement upon the old plan, for instead of plowing only one side of the row at a time, now, by the use of the cultivator, the planter is enabled to run a furrow on both sides at the same time, or can make two or more furrows on each, owing to how many plows he has attached to his cultivator. The hoes follow the plows in a few days, pulling the grass from the young cotton and setting upright such of the plants as have been turned down by the dirt from the plows. This throwing the dirt to and from the cotton and hoeing is kept up until the planter is satisfied he has subdued the grass and weeds, when all the middle is thrown to the plant, and nothing more is done to it until it opens and is ready for picking.

The picking or gathering season begins generally from the middle of August to the latter part of that month. There have been several machines invented to pick cotton, but thus far all have proved impracticable and comparatively useless; hence the old process is kept up, viz: The cotton is gathered in sacks made out of strong Osnaburgs cloth; these sacks are suspended over the neck and shoulders and from which it is emptied from time to time into large baskets, made generally out of white oak splinters and capable of holding about 150 pounds of seed cotton. It is generally weighed at noon and at night and the baskets emptied into wagons and conveyed to the gin house, where it is ginned and the lint extracted from the seed and packed into bales weighing from from 400 to 600 pounds. It is then ready for market, and these bales are placed upon wagon, and conveyed to the nearest town or depot and there sold or shipped to another market. The handling and ginning has much to do with the commercial value of the staple, as trash and dirt seriously affect the value, and often by careless ginning or defective machinery the staple is cut and thereby damaged. Many planters pack their seed cotton in bulk in the gin house and allow it to become heated in a short time; this heating causes the oil to exude from the seed, so that when ginned the lint presents a glossy, creamy appearance which is highly prized by some purchasers; but this is a rather dangerous experiment, as too much heating causes putrefaction and mildew, which gives the lint a blackened appearance, and serious damage will result.

There is probably no article of commerce for which more improvements have been made for handling and preparing for market than for cotton.

The implements and machinery used during the early periods of cultivation of cotton were of the simplest and most primitive kind. First, we find that the mode was to separate the seed from the lint by the fingers, and then 50 pounds of seed cotton were regarded as a good day's work for one hand. Next we find substituted the small roller gin. It was ordinarily attached to the middle of a rude bench supported on legs inserted in auger holes. Astride of this two boys, seated face to face, operated each by turning a crank, one feeding the rollers with seed cotton, the other feeding them from the lint on the opposite side as it was drawn through, leaving the seed behind. The rollers were less than an inch in diameter and about 8 inches long, revolving, of course, in opposite directions but in close contact. The next advance step was a gin by which the rollers were rotated by means of a treadle worked by the foot, leaving both hands of the operator free to attend to the rollers. This description of gin was used in the West Indies in 1764. But the dawn of a new era was near at hand, for, on the 14th of March, 1794, Mr. Eli Whitney obtained a patent for a gin which has not only added to the wealth of our

nation, but has extended the manufactures and commerce of the world in a degree without a parallel in its history. I shall not occupy time nor space to describe this machine; suffice it to say that this invention was but the beginning of others and more extensive improvements in preparing cotton for market, which have continued to the present time, until now the cotton-ginning has advanced from 50 pounds picked per day by hand to the ginning by our improved gins of 15 bales weighing 500 pounds each per day. With the improved ginning also comes the improved method of picking or baling cotton, for now, instead of the old system of hanging up a sack to be filled and packed by the feet, each sack holding about 50 pounds of lint, we have iron screw presses operated by steam, packing from 40 to 50 bales daily of the average weight of 500 pounds, and these bales are repacked by a powerful steam compress for shipment, whereby they are reduced to less than half the former size, these compresses being capable of compressing one bale each minute. The covering formerly used for bales was bagging made from hemp principally grown in Kentucky and Missouri, and the cotton and bagging was baled together by ropes made from the same material and tied tightly around the bale, but those have been superseded by jute bagging and iron ties, which have been used almost exclusively until the past year (1888), when a white bagging made from inferior cotton began to be made by mills in New Orleans, which has been used to a considerable extent.

With improved methods of cultivating cotton, and with improved machinery for preparing it for market, has also come an immense increased demand for it and for goods manufactured from it, until to-day the cotton crop of the United States has increased from a few thousand bales, valued at $150,000 at the time of introduction of the Whitney gin, to 7,000,000 bales averaging nearly 500 pounds each and valued at $275,000,000. As shown by the report of the Department for 1887, we now export to England about 69 per cent of our 7,000,000 bales raised, for which she pays us about $177,895,500, and this does not include another product of cotton, viz, cotton, seed oil, cake, and meal, for which she pays us, or rather Europe pays us, the handsome sum of $8,888,626.

Cotton may well claim to be king, for there is no article that enters so largely into manufactures as cotton ; indeed, we find it in nearly all classes of manufactures, from the thinnest lace to the compact car wheels ; indeed, it has become so identified with the wants of mankind, is so essential to the industry and capital of the world, that to withhold the produce of a single crop from our principal customer, Great Britain, would to a great extent involve her manufactories in ruin and reduce her operatives to pauperism, and seriously damage all commercial interests and relations. So great is the importance of cotton to-day, should any dire calamity befall the land of cotton, thousands of merchant ships would rot idly in dock, thousands of mills must stop their busy looms, and millions of mouths would starve for lack of food to feed them.

HEMP.

A complete and representative series of specimens illustrating hemp culture and manufacture was secured, chiefly from Kentucky. Hemp cultivation is almost exclusively confined to this State, which produces nine-tenths of all the hemp grown in the country, and the greater part of this comes from the three counties of Fayette, Franklin, and Jessamine, the two first named leading in late years. It is grown in small quantities in a dozen other counties. Formerly Missouri grew almost as much hemp as Kentucky, but its cultivation has steadily declined until at present it supplies a mere trifle. A few other States grow very small quantities.

As long ago as 1842, the production of hemp in Kentucky amounted to over

RETTING HEMP (KENTUCKY).

HEMP-BRAKE IN OPERATION.

15,009 tons. In the following table the hemp production of five States is given since 1850 :

States.	1850.	1860.	1870.	1880.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Kentucky	17,787	35,065	7,777	4,583
Missouri	16,028	17,295	2,816	209
Tennessee	595	1,040	1,033	......
Pennsylvania	44	43	571	......
Illinois	....	804	174	61

Four other States produced hemp in 1880, viz: Michigan, 78 tons; Kansas, 72 tons; Minnesota, 20 tons, and North Carolina, 2 tons. The entire product of the United States in 1880 was 5,025 tons.

These figures show a steady decrease between 1860 and 1880, probably due to the decline in American shipbuilding, and to the introduction of manilla fiber, the celebrated manilla hemp, Musa textilis, produced in such quantity in the Philippine Islands. The figures will doubtless show an increase when the next census is taken, from the fact that considerable quantities of hemp are now used in the manufacture of binder twine for use in the machine-binding grain harvesters. In former years considerable cordage was manufactured within the borders of the State, although now the industry has declined greatly and probably a majority of the hemp grown in the State is manufactured in other sections, going to the New York and Boston markets chiefly. There is no reason why the production of this useful fiber should not be generally extended for use in twine manufacture.

In November, 1888, I visited the "Blue Grass region" of Kentucky, which is the center of hemp production, and, through the courtesy of Mr. W. B. Hawkins, not only secured valuable specimens for the agricultural exhibit, but considerable interesting information regarding hemp culture. Mr. Hawkins is a successful hemp-grower, having raised as high as 1,648 pounds per acre. His average yield last year was 1,400 pounds per acre for a field of 65 acres. Hemp is grown in rotation, small grain followed by clover, putting the ground in the very best condition for the growth of the fiber. The hemp is cleaned in the field, the cumbersome slat brake, which has been in use for a hundred years or more in Kentucky, being still employed. The cleaning is done in the field in order that the waste portion or shive may be returned to the soil again.

This is burned and the ashes spread over the land, as the waste in its unrotted state would be injurious to the soil. One of these old-fashioned brakes was secured for the Paris Exposition, but the fiber exhibit having reached proportions that the space allotted to it was altogether inadequate, it was not thought best to send it. A fine photographic enlargement of the brake and negro operator is to be seen, however, as well as enlargements of other scenes in the hemp field, as cutting, spreading, etc. (See Plates LII and LIII.) A negro operator with this cumbersome affair can clean 150 pounds of hemp in a day. Speaking to Mr. Hawkins of the need of improved machinery for cleaning hemp, it was stated that the old method suited the colored people better, as breaking hemp in the winter was the main dependence for many of them.

The farmers of this section, as a rule, dewret their hemp. although it is stated that the manufacturers prefer, and the Navy Regulations require, a water-retted hemp. As long as the hemp product is used chiefly for twine and cordage, the extra labor and expense necessitated by water-retting is hardly warranted. With demand for spinning hemp at better prices there will be a call for water-retted fiber. We were shown in Frankfort, at the Kentucky River Mills. crash toweling from hemp that had been in use for many years, and to all appearances it was as good as the same grade of fabric from flax. It is said that Henry Clay introduced into Kentucky the

practice of retting by water, but few farmers are willing to take the trouble to follow it.

The hemp stalks are usually spread upon the same ground where grown, and when sufficiently retted, as is determined by breaking out a little, it is again put into shocks. Hemp rotted in winter is of a brighter color than that spread in October. The crop requires a rich, loamy soil.

The only hemp which comes into direct competition with the American is that imported from Russia. We are told that the American hemp, however, possesses greater flexibility than the Russian, and can be dressed finer, although the Russian is more equal in length, and, while less flexible, is preferred when the cordage is to be used for shrouds and stays in the rigging of vessels. It may be suggested, by the way, that the modern use of wire cables for portions of the standing rigging of vessels may have influenced slightly the decline in the demand for tarred hemp for rigging. The best hemp comes from Italy, though very little of it appears in our market. The principal uses of hemp in this country are in the manufacture of cordage, binding and other twines, and for mixing with flax in a cheap grade of carpet warp.

Glancing hastily at the exhibits of hemp in the fiber series, the first exhibit illustrates the product in the hands of the farmer, the seed, stalk, shive, and fiber ready for market being shown. A second exhibit shows the manipulation known as dressing (single and double), including softening, and the production of tow, as prepared for the eastern markets. Then follows the purely manufacturing exhibits, when are shown various stages or processes in the production of fine and coarse twine, tarred rope, etc.

These samples have been donated by the E. R. Sparks Manufacturing Company, Lexington, Kentucky; the Kentucky River Mills, Frankfort; the A. H. Hart Manufacturing Company, 90 White street, New York City; and the Tucker & Carter Cordage Company, 34 Pine street, New York City.

Mention must be made of a beautiful sample of hemp, almost white in color, and as fine as flax (No. 48), which was especially prepared for the hemp collection by the new bleaching process of Dr. R. R. Roberts, of Washington, District of Columbia. This sample of hemp was prepared from specimen No. 3 of the hemp series, a small fragment of which, in its crude state, also appeared with the prepared sample for purposes of comparison.

A word concerning the history of hemp. Its native home is India and Persia, although it is in general cultivation in many parts of the world, both in temperate and more tropical climes, though only in large quantities for export in Russia and Poland. French hemp is much valued, but the finest quality comes from Italy, and is pronounced fine, soft, light-colored, and strong. Hemp grows in all parts of India, and in many districts flourishes in the wild state. It is but little cultivated for its fiber, although Bombay-grown hemp in former times was proved to be superior to the Russian. In portions of India, as well as other hot countries, it is cultivated for its narcotic products, the great value of which makes the Indian cultivators indifferent about the fiber. When it is grown for the narcotic principle, which forms the intoxicating drug called Bhang (Hasheesh), the plants are placed some distance apart, so that the air and sun can get to them. Hemp is largely grown in Japan for the manufacture of fabrics. This industry is very old, as prior to the introduction of silk weaving it was the only textile of the country.

FLAX.*

The flax series is neither complete nor interesting from the European standpoint, where as a rule the flax is grown and used for weaving into the finer linen fabrics.

* Since this report was written, and while going through the press, there has been a revival of interest in American flax culture. Later information on this subject will be found in recent publications of the Department of Agriculture, emanating from the office of Fiber Investigations.

In America, in past time, a fair grade of flax fiber was produced, which was utilized to some extent in linen manufacture, and in comparatively recent years Canada and New York State have supplied a grade of flax suitable for the manufacturers of crash and similar coarser fabrics, though it has not been possible to secure for the American flax exhibit in Paris a single sample of this grade of fiber. Up to 1870, and for thirty years previous, large areas were cultivated in flax both for seed and for fiber, but latterly for the seed chiefly, as the demand for flax fiber has greatly declined. Where utilized it was employed for such purposes as the manufacture of bagging and twine principally.

In 1850 the production of raw flax for the whole country amounted to 7,709,676 pounds, falling in 1860 to 4,720,145 pounds, while according to the census of 1870 there was a product of 27,133,034 pounds. Of this quantity over 87 per cent was grown in the three States of Ohio, New York, and Illinois; Ohio alone producing over 17,000,000 pounds. In order of quantity, New York, and Illinois come next with something over 3,000,000 and 2,000,000 pounds respectively. These States are followed by Pennsylvania, Iowa, Wisconsin, Michigan, Kentucky, and New Jersey, all producing above a quarter of a million pounds, Pennsylvania and Iowa together producing 1,500,000 pounds. The States of Ohio, Indiana, and Wisconsin had a little more than 150,000 acres under flax cultivation in 1869 and about 250,000 acres in 1877–'78. In 1869 Ohio produced 17,880,624 pounds of fiber and in 1877–'78 but 7,343,294 pounds, a tremendous falling off. I can not find satisfactory reports of amount of fiber produced in other States for the last-named date, but the figures of seed production show an enormous increase in cultivation in Western States, especially Kansas and Iowa. In 1869 Kansas produced but 1,553 bushels of seed, and Iowa 88,621 bushels. In 1877–'78 the production of the same States amounted to 291,309 bushels and 529,878 bushels of seed respectively.

The figures for the census year in States of heaviest production are as follows:

States.	Seed.	Fiber.	States.	Seed.	Fiber.
	Bushels.	*Pounds.*		*Bushels.*	*Pounds.*
New York	72,372	843,965	Wisconsin	547,104	2,124
Ohio	593,217	123,367	Kentucky	2,192	48,491
Illinois	1,812,438	167,807	West Virginia	1,417	44,398
Indiana	1,419,172	25,181	Virginia	4,526	66,264
Iowa	1,511,131	81,354	Oregon	21,742	28,199
Kansas	513,616	1,150	California	45,770	....
Missouri	379,535	19,452	Dakota	26,757	....
Minnesota	98,689	497	New Jersey	5,283	46,701

The production for the United States in the census year 1879 amounted to 7,170,951 bushels of seed and 1,565,546 pounds of fiber.

It should not be understood that fine flax is not manufactured in the United States. Nearly all grades of the fiber are used by various manufacturers dependent upon the kinds of goods produced, though for all fine fibers, and even crash, foreign or the Canadian flax is used. When the grade of flax used in crash could be obtained in this country, chiefly from northern New York, one of the largest manufacturers made a difference of one-half per cent in favor of American flax even the Russian or Canadian of the same grade, if as well dressed. But here comes in a serious consideration. From want of experience and united action on the part of American growers, as well as the uncertain element of labor, American flax was seldom prepared twice alike, and a manufacturer could not tell what he was buying without first making tests with small samples. Another point is that in thread manufacture the imported was preferred because it worked more smoothly than the native, and the color was better, the bad color being caused by bad retting.

At present the principal use of flax fiber in this country is for the manufacture of twine, and for tow for various uses. Very little if any bagging is now manu-

factured from flax, although at one time thousands of bales of flax tow were consumed in this industry. The production of St. Louis alone in 1871, just prior to the reduction of duty on jute, was 3,250,000 yards, the raw material of which was as follows: flax tow, 14,199 bales; jute and jute butts, 8,561 bales; hemp and jute tow, 4,756 bales. Another cause for the falling off in the manufacture of flax bagging was the discrimination, in 1878, of the various cotton exchanges of the country against flax bagging on account of the cotton being injured by fragments of the "shive" which becomes mixed with it.

In the series of flax specimens in the fiber collection of the United States Agricultural Exhibit there are several fair specimens of flax suitable for coarse uses. The A. H. Hart Co., of New York, supplies a good sample of Michigan flax and of fine twine from it. The Boyce Fiber Company, of New York, sent a beautiful series of both flax and hemp, prepared by an entirely new process, which does away entirely with both dew and water retting, thereby saving considerable time and considerable expense in the preparation of the fiber for the market. A lighter-colored fiber is produced, some of the samples being almost white. Tests by Eastern manufacturers have been shown in the fiber to be one-third stronger than the flax as cleaned by the usual methods. The process is quite simple, and is equally adapted to the preparation of hemp, jute, and other best fibers. A fine sample of hemp prepared by this process accompanies the exhibit. The flax series includes the flax straw unretted, half broken flax straw (no chemicals having been used), undressed fiber, flaxed tow and dressed flax, yarn from same, and manufactured fabric.

From F. H. Peavy & Co., Minneapolis, Minnesota, other flax samples were received. An exhibit illustrating the various processes of flax manufacture, from the Museum of the Department of Agriculture, is also shown. There are also specimens of green flax, flax tow, and other miscellaneous exhibits. Dr. R. R. Roberts, of Washington, District of Columbia, also contributed a handsome sample of flax, prepared by the new process. From the Sioux City Linseed Oil Works was received a fine exhibit of oil, oil cake, and ground meal, representing the linseed-oil industry.

RAMIE.

The ramie plant was first introduced into the country in 1855 from the botanical gardens of Jamaica and cultivated in the United States Botanical Gardens. Subsequently it was grown in the experimental garden of the Department of Agriculture. In the year 1867 it was given a fair test in different localities, and its adaptability to culture in this country abundantly proven. Experiment has been made with the plant in Louisiana, and other portions of the South, at Camden, New Jersey, where its cultivation was conducted by Mr. Emil Lefranc, the experiments being repeated at Haddonfield and Newark by other gentlemen interested in ramie culture. It has also been grown in Maryland and Virginia, but in spite of the partial success of these experiments it is evident that ramie culture in States north of Mason and Dixon's line will never be successful. About the time of Mr. Lefranc's experiments the legislature of New Jersey passed an act to encourage the production and treatment of fibers in the State, bounties being offered, among others, for ramie, as follows: For every ton of 2,000 pounds of ramie stalks not less than 2½ feet long, $10; fractions of not less than a quarter of a ton, at the same rate. For every pound of disintegrated ramie, ready for combing, 5 cents; for every pound of ramie yarn ready to weave, 10 cents. Circulars giving full information on the subject were issued by State officers, and many farmers made attempts to cultivate it. Excellent specimens of fiber were produced, but in two years not a single claim was made for bounty, no one having produced it in sufficient quantity.

Successful experiments have been conducted at Yorktown, Texas, by the Texas Ramie Growing Association, fine examples having been produced by Mr. Felix Fremerey and Mr. Frederick Natho. The principal samples of American grown ramie. stalks and ribbons of fiber as removed from them, are contributed to the Exposition by these gentlemen. Regarding the various machines for decorticating ramie nothing can be said in this report, as the question of fiber machinery has not been considered in making the fiber exhibit, nor will any machines be shown in the United States agricultural exhibit.

Ramie is a plant belonging to the nettle family (*Urticaceæ*), which from time immemorial has been cultivated in China, and known to botanists by the name *Boehmeria nivea*, frequently called the stingless nettle. It is also known as China-grass, and rhea. It has long been cultivated, also, in Japan, in Java, Borneo, Sumatra, and in the East Indies, and during the present century has been introduced into other countries.

When fully grown the plants attain a height of 4 to 8 feet, clothed with large ovate-acuminate leaves that are green above and whitish or silvery beneath, the fiber being formed in the bark which surrounds the stalk, this having a pithy center. It is of rapid growth, and produces from two to four, or even five, crops a year without replanting, dependent upon the climate where cultivated. In China and Japan, where the fiber is extracted by hand labor, it is manufactured not only into cordage, fish-lines, nets, and similar coarse manufactures, but woven into the finest and most beautiful fabrics. In England, France, and Germany the fiber has also been woven into a great variety of fabrics, covering the widest range of uses, such as lace, lace curtains, handkerchiefs, cloth, or white goods resembling fine linen, dress goods, napkins, table damask, table-covers, bedspreads, drapery for curtains or lambrequins, plush, and even carpets and fabrics suitable for clothing. The fiber can be dyed in all desirable shades or colors, some examples having the luster and brilliancy of silk. It is one of the strongest and most durable of fibers, is least affected by moisture of all fibers, and from these characteristics must take first rank in value as a textile substance. It has three times the strength of Russian hemp, while its filament can be separated almost to the fineness of silk. In manufacture it has been spun on various forms of textile machinery, and also used in connection with cotton, wool, and silk, and it can be employed as a substitute in certain forms of manufacture, where elasticity is not essential, for all of these textiles, and for flax also. It likewise produces a superior paper, and can be utilized in the manufacture of celluloid. In short, the uses to which it can be put are almost endless, and when the economical extraction of the fiber by machinery is successfully accomplished it will become one of the most valuable commercial products of the vegetable kingdom.

The plant is propagated by seeds, by cuttings, or by layers, and by division of the roots. When produced from seeds the greatest care is taken with the planting, as the seed is very small. For this reason open-air planting can hardly be relied upon, plants started in the hot-bed giving the best results. After planting the seeds are covered thinly with sifted earth and kept shaded from the sun until the young plants are 2 or 3 inches high, when sunlight is gradually admitted to them. In five or six weeks they will be strong enough to transplant in the field.

In the East Indian method of propagating, by cutting of the stems, the spring-grown stems are used, and when fully ripe. Only the well ripened portion, where the epidermis has turned brown, is employed, the stem being divided into lengths that will include three buds, care being taken to cut a quarter of an inch above and the same distance below the top and bottom buds. These are planted with the central bud on a level with the soil. The cuttings are shaded for 10 days or more unless the weather be cloudy or rainy. In India the cuttings are planted a foot apart, although given more room as the plants mature.

By far the most practical method, and the one which will give the best results in this country, is the propagation by a division of the roots of old and fully matured plants. The old plants are better than young ones for the purpose, as the root-mass is larger, the tuberous portions showing a greater number of eyes and therefore giving stronger plants after division. The practice varies as to distance apart that these are planted. In India 4 feet apart each way is considered the proper distance, though in France some favor 2 feet apart each way as giving better results. One method in vogue in this country is to plant out in furrows 5 or 6 inches deep and 5 feet apart, opened with the plow; the roots laid lengthwise in close succession. Three thousand plants per acre will be required.

The plants are given cultivation at first, being hilled like corn or potatoes, all weeds being kept down, though after getting a good start, from the rankness of their growth and the density of the foliage, weeds will have but little chance to grow. These brief directions are sufficient to enable any one to make a beginning; experience and a familiarity with the plant and its manner of growth will suggest subsequent treatment and assist the farmer in establishing the peculiar practice that it will be best for him to follow. Southern cultivators choose a deep, rich, light, and moist soil. Mr. Montgomery, writing on the culture of the plant in the Kangra district of India, states that a rich loam suits the plant best, but they will grow in any kind of soil, provided a full supply of moisture is available, combined with thorough drainage.

If sufficient moisture can not be assured it should be supplied by irrigation, a positive essential in many localities where ramie is grown. It must be remembered, however, that ramie will not thrive in a wet soil. The ground must be well prepared by plowing to the depth of 10 inches, and well pulverized, and if the land is poor fertilizers must be applied to bring it up to a good state of fertility. All weeds must be removed from the soil or they will sorely plague the cultivator in the first year or so until the plants have grown large. When the climate will admit of producing three crops a year, the cuttings are made at intervals of about ten or twelve weeks, the first cuttings to be made about the middle of May, dependent on the season. The plant thrives best in the Gulf States from Florida to Texas, and also grows to perfection in California.

JUTE.*

Every year larger quantities of jute are consumed in the United States. American loomers are annually weaving this fiber into a greater variety of elegant fabrics. But the yarns from which these articles of use and luxury are wrought are all spun in Dundee. Our manufactories should be supplied with home-grown material. In 1887 the factories of St. Louis made 15,000,000 yards of jute baling. There are now in the United States 23 bagging mills with 500 looms. Their full capacity is 60,000,000 yards, enough for a cotton crop of 8,750,000 bales. All of the jute which these factories consume is brought from India. It should be produced at home. In 1888, 230,326,000 pounds of jute, costing $3,377,000, were imported to this country. Our patent binders use annually 80,000,000 pounds of twine in the wheat fields of the United States. Texas alone consumes 10,000,000 yards of jute bagging a year. In 1888, our cotton crop required 40,000,000 yards of baling, worth $3,675,000. Last year the South raised 7,000,000 tons of cotton seed. Of this quantity ahout 1,600,000 tons were used in the manufacture of oil cake and meal. The seed utilized for commercial purposes would fill 48,480,000 bags worth $2,636,000. In 1887 the number of sacks needed to handle the cereals and other products of California was 35,000,000, worth $2,625,000. In 1887 our crops of buckwheat, rye,

* The statements herewith presented, relating to the cultivation of jute in the United States, were prepared by Prof. S. Waterhouse, of Washington University, St. Louis, Missouri.

barley, potatoes, wheat, oats, and corn amounted to more than 2,792,000,000 bushels. The number of sacks necessary to hold this enormous product would be 1,116,843,000, costing at current rates $83,763,000. These productions, though transported by railroads in bulk, are mostly carried in sacks from the farms which produce them to the elevators which transfer them to the trains. The business of St. Louis shows that no insignificant quantity of grain is still carried to market in bags. In 1887 the shipments of wheat to this city were 15,510,000 bushels. Of this amount of wheat 4,124,000 bushels were brought in sacks. This is a surprisingly large portion. Presumably only a few thousand bushels, raised in its immediate neighborhood, would be brought in bags to a great railroad center. The preceding figures note a possible demand that is far in excess of the natural consumption. The removal of sacks from year to year forms only a small percentage of the whole number. Then, too, probably large quantities of agricultural products may be conveyed in bulk from the farms to the railroads and manufactories. But after these estimates have been lowered by the largest reductions which business experience can suggest all the economy of planters may require, the number of bags requisite for the initial movement of our agricultural productions is still immense. In 1888, all of the crops of Texas were injured by the long and severe drought; but in 1887 the climate permitted a fair test of the capability of the State to raise jute. Tracts of 25, 50, and 400 acres were planted. The height of the mature stalks, varying with the different conditions of moisture, ranged from 6 to 12 feet. In a report of the luxuriance of fields of jute which came under his observation, a planter writes, "Every farmer who had made a trial was highly delighted with the success, the jute having on the average reached a height from 10 to 12 feet, although planted broadcast." Some of the stalks which were left for the seed to ripen grew to the height of 18 feet, but their fiber was too coarse and woody to be of much textile value. When the seed was planted in drills, the number of stems to the acre was about 200,000; when it was sown broadcast the number was still larger. The product of 30 pounds of seed to the acre was 3,500, and in instances of unusual fertility 5,000, pounds of fiber per acre. The yield of Indian fields rarely reaches 3,000 pounds of fiber per acre. Some of the jute ribbons which were stripped from the stalks by machinery were rotten in four days. Personal knowledge enables the writer to speak with confidence of the quality of Texas jute. The specimens examined were grown in 1888.

The fibers were fine, strong, uniform in color, perfectly distinct, and wholly free from bark, wool, gum, and stain. The jute was as good as the earth produces. The specimens were accompanied by an assurance that such fibers, all ready for the comb, cost the Texas planter from $2\frac{1}{6}$ to $2\frac{1}{3}$ cents a pound. The farmers of Texas, basing their confidence upon the results of their own experiments, fully believe that the cultivation of jute in the Southern States will yield a net profit of from $40 to $60 per acre.

Representative specimens of American-grown jute were on exhibition in the fiber collection of the United States Agricultural Department on Quai d'Orsay. The best specimens were sent by Mr. Fremery, of Yorktown, Texas, and grown and prepared by Frederick Natho, of Yorktown. These are stalks as cut, with the prepared fiber from them. Other samples are exhibited from Mississippi and Louisiana, grown in these States and prepared on various machines or by processes, in which the donors had an interest. Among the jute samples sent by Mr. A. L. Redden, of New Orleans, who contributed a series both of ramie and jute, there is a piece of jute carpet. Two large bundles of jute and ramie stalks from the Yorktown, Texas, plantation are also exhibited. Another specimen comes from Parker County, Texas, the stalks being long and fine. Regarding the jute grown in Parker County, Mr. James R. Binford writes as follows:

"I have even seen in Parker County, northwestern Texas, near Weatherford, a field of 20 acres of jute. This field was the property of the Franco-Texas Land Company, and whilst the product should have been cut in September or October it was yet standing in January. I inquired the cause, and was informed by Mr. Lavet that they had been unable to find machinery to properly decorticate it, the machinery they had having proved a failure. In a conversation with Prof. W. C. Stubbs, in charge of the experiment station at Baton Rouge, Louisiana, he informed me that Louisiana had been unable to find proper machinery to work jute or ramie profitably; that too large per cent of the work had to be done by hand to make it profitable. It may be stated that the Department of Agriculture knows of no machinery, at this date, with which jute could profitably be cleaned, though claims that there are suitable machines have been put forth from time to time by interested parties. The history of this plantation of 20 acres fully illustrates the folly of inducing farmers to grow a product that they have no earthly way of harvesting save by the rude method of water setting, in vogue in India. The question of culture in the United States is settled, and this is as far as the industry has progressed in this country at the present time.

THE MALLOW FIBERS.

In the mallow family (the malvaceæ) are included a large number of fiber-producing plants, some of which are more or less cultivated for their fiber, and many that might be cultivated if there was a sufficient demand for their product. To this group belongs the cotton plant, though cultivated for the fiber of its seed pods, or bolls, and not that which may be extracted from its stalk. The well-known okra plant, so common in the Southern portions of the United States, produces a very fine bast of fiber when properly cultivated. Three species of mallows, and perhaps four, might be grown successfully in the United States, all of which have passed the stage of experiment and need only to be grown in quantity to find a market. Inferior samples of these, only, could be obtained for the fiber exhibit which unfortunately is not wholly creditable in this direction. The effort was made to obtain representative examples, but owing to the fact that the plants have not been grown for fiber in late years, old specimens in the Museum of the Department of Agriculture had to be substituted.

Abelmoschus esculentus (Okra.)—This is a native of the West Indies, as useful as an article of food as for its fiber. It is cultivated in southern France for its pods and is well known throughout the southern portions of our own country as producing a favorite vegetable used largely in soups. It has never been grown for its fiber to any extent in the United States, although paper has sometimes been made from it, but not in sufficient quantity to become an industry. Like other fiber-producing plants when grown for fiber the seed is sown thickly in order that the stalks may be straight, smooth, and regular, with as little branching as possible. When grown for its pods, on the contrary, the same course is adopted as that followed in growing flax for seed, where plenty of space for branching is desirable. The fiber is extracted in the same manner as hemp. In color it is as white as New Zealand flax and is therefore lighter than jute as generally exported. The fiber could be employed in the manufacture of twine, coarse bagging, burlap, etc., if it could be produced economically. At this time, however, there is no satisfactory machine for cleaning the fiber.

Mr. James R. Binford contributes the following facts regarding this plant:

"Okra, or gumbo plant, is chiefly found in the Southern States and is very similar in its appearance to the cotton plant, and can be grown very successfully in any climate and on any soil that will produce cotton, and its mode of cultivation is about the same. Its pods are used in the South, and especially by the creoles of Louisiana, for soups, and especially in a soup known as gumbo; hence the name

often given this plant. The plant grows to great perfection upon soil that would not successfully grow either hemp or jute, and it is astonishing that it has had so little attention and has been so little utilized. During the late civil war, when the Southern States were cut off from communication from the rest of the world by a rigidly enforced blockade, coffee became very scarce and difficult to obtain. During this time many of the people of the Southern States, and especially the poorer classes, utilized the seed of the okra plant by either mixing with coffee or using it alone, and I have often been told they found the seed thus prepared a very fair substitute for coffee.

Hibiscus moscheutos (Swamp rose mallow).—This is a closely allied species to the preceding, indigenous, and found in many portions of the country, usually in marshes, or upon the margins of streams, or in low or wet places, though experiment has shown that it thrives on the uplands as well. Experiments in New Jersey about ten years ago were so successful it was thought by those conducting the experiments that it produced a fiber equal in quality to jute, and possibly better than that from *Abutilon avicennæ*. This is mere conjecture, however, and in the absence of careful tests the exact value of the fiber, compared with hemp as the standard of strength, can not be stated.

Abutilon avicennæ (Indian mallow)—This is another malvaceous plant that has been cultivated in the United States to a limited extent. It is an annual, usually growing to the height of 4 feet, though in cultivation stalks 6 feet high are not uncommon, and Prof. Waterhouse records a height of 8 feet in Missouri. Gray states that it was introduced from India, and when found in a wild state has escaped from cultivation. It grows so freely upon rich soil, even thrusting itself in and growing spontaneously, that it is almost considered a farm pest in many portions of the country. It grows luxuriantly throughout the West and North, the lines of States from Ohio to Missouri producing even now vast quantities of the fiber, which rots and goes to waste upon the stalks every year. The fiber is strong, glossy, and white, and the ligneous body of the plant gives more cellulose for paper stock than many other species.

Fully twenty years ago it attracted considerable attention in the West, and particularly in Illinois, through the endeavors of Mr. J. H. McConnell, who demonstrated its value by manufacturing it into thread, cordage, rope, etc. A State fair committee in 1871 reported upon these manufactures and stated that the fiber gave flattering promise of utility. According to this report the plants are stated to grow 9 to 14 feet high; that the seed should be sown 12 to 16 quarts per acre, in corn-planting time. The crop is treated in the same manner as hemp until cured, then water-retted like hemp; a volunteer crop will spring up the last of July which can be retted. The cost of cutting is given as 75 cents per acre; water-retting, $10, dew-retting, $5; hand cleaning $12, and half as much by machinery, making the total cost, not including rent for land, $19 to $31. Messrs. McConnell offered $100 per ton for all water-retted that could be furnished and $75 for the dew-retted. The crop is not exhausting to the soil if the refuse is restored to it.

It is stated that an acre of ground will produce 5 tons of Abutilon stalks, and about 20 per cent of pure fiber is obtained after preparation. Considered superior to jute fiber as imported, the long fiber is fully equal in value to Calcutta prime jute, and Philadelphia rope-manufacturers have already offered to buy any quantity at the highest market price for jute. Bleached and cottonized for fabrics, Mr. Le Franc pronounces the Abutilon fiber good for weaving tissues and mixing with a certain class of woolen goods. *Abutilon avicennæ* in its crude state is worth from eight to ten dollars per ton. Ten years ago Mr. Emile Le Franc considered it superior to Indian jute and finer than manila hemp, and he classifies it in value between manila and Italian hemp.

"Extracted from the the plant in its young stage it would be fine enough for tex-

tile fabrics, such as carpet yarns and fillings. It takes readily to any colors and its natural luster displays more in the aniline dye than in any other, a great advantage over Indian jute, which is antagonistic to cheap bleaching and dyeing."

Experiments were made with this plant some years since, when it was reported to have yielded 20 per cent of pure fibre of a superior quality, and, when bleached and cottonized for fabrics, good for weaving tissues and for mixing with a certain class of woolen goods. It is to be regretted that a good specimen of this really valuable American fiber could not be obtained for the American fiber collection exhibited in Paris. The sample shown is not only inferior, but has changed color materially in the ten years it has been on exhibition in the fiber collection of the Department of Agriculture.

Gossypium herbaceum (the cotton plant).—Specimen No. 6 in the small group of mallow-fiber samples is a section of a stalk of the cotton plant, the bark of which has been treated for its fiber. It was prepared by the American Consolidated Fiber Company from a green stalk treated 60 days from time of planting and which grew on the plantation of Gov. J. B. Gordon of Florida. In the letter accompanying the specimen it is stated that "the fiber is not only good for thread, but for a thousand other purposes; it is a splendid fiber for paper also; it will not easily tear as does that made from wood pulp or rags. Eighteen million acres of such fiber as this are yearly thrown away, while for paper alone it would be millions of dollars in the hands of the planters."

To be available for fiber the plants would need to be grown very closely together, as all fiber-producing plants are grown, in order that the stalks should grow straight and smooth without branching.

THE LEAF FIBERS.

There are several species of fleshy-leaved plants growing in the extreme southern borders of the United States, which produce valuable fiber. A complete series of these are shown, though for the most part they are old specimens taken from the collection of the Department of Agriculture. The series includes eighteen numbers and about ten species, as follows:

Agave americana (the Century plant or American Aloe, producing fiber known as *Pita* *).—The plant is grown in many parts of the world. In America it is found most abundantly in Mexico and Arizona, where it is used for cordage, or, matted together in a mass and tacked at regular distances, it is utilized for rough saddle cloths. In the West Indies it is used by the negroes for making cordage, hammocks, and fishing lines, and in Mexico it finds use in the mines to some extent for rope and heavy cordage. The fiber of the young plants is fine and white, though necessarily short. The more mature the plant the coarser and longer the fiber.

Agave rigida, var. *sisalana* (Mexican grass, Sisal hemp).—This species is confined to smaller limits than the preceding, belonging to the new world, and found chiefly in West India Islands, Yucatan, Central America, and the southern part of the Florida peninsula.† Dr. H. Perrine introduced it into Florida in 1838 and since that time it has spread over many of the keys and along the southeast and southwest coasts of the State proper. Large quantities of sisal, from Yucatan, are manufactured into cordage in New York every year, and its consumption is increasing. It is one of the foliaceous fibers that might be produced profitably, were the business once fairly established, with suitable machinery, for the New York manufacturers would buy it in preference to that from Yucatan, if as well prepared, for the fiber is better.

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*This name is sometimes applied to *Bromelia sylvestris*, though it has been given to several species of fiber plants.

†See special bulletin published by the Department of Agriculture on Sisal Hemp Culture.

The Yuccas.—Several species of yucca are represented in the collection, as *Y. filimentosa*, *angustifolia*, *aloifolia*, *brevifolia*, and *baccata*. These plants thrive in nearly all portions of the United States and produce a fiber similar to that produced by the agaves, though there is no record to show that it has ever been employed or manufactured other than experimentally. The shortness of the leaf doubtless has prevented its use by the cordage-manufacturers. It is used to some extent by the Indians and the Mexicans of Sonora and Arizona in the manufacture of a rough cordage, ropes half an inch or more in diameter, made from it, having been secured by the Department collection in Washington. The fiber possesses a moderate tenacity, but is somewhat brittle and harsh.

Dasylerion graminifolium (Bear grass).—One sample of the fiber of this plant is exhibited, said to come from Texas. It resembles istle somewhat and is probably the least valuable of the several leaf fibers that have been named. The term "bear grass" is also applied to the *Yucca filamentosa.*

Tillandlia usenoides (Spanish or Southern moss).—This peculiar plant belongs to the same family as the preceding species, though differing most widely in habit. In its native state it is found along the Southern or Gulf coast and to some distance inland, clinging in long, gray festoons from the branches of trees. In Brazil it is used by the country people to fill mattresses, cushions, etc., and also as packing for glassware or porcelain. In our country it is employed in the manufacture of vegetable hair and forms an admirable substitute for the curled hair used by upholsterers. The outer cellular portion is removed by steeping the plant in water, when the filaments change their color from gray to black, preserving the harsh, wiry appearance of curled hair. There are samples of both moss and "hair" in the fiber collection, including a bale of the prepared product.

OTHER FIBROUS SUBSTANCES.

One of the most interesting exhibits in the fiber collection is the series of pine-fiber specimens furnished by the Acme Manufacturing Company of Wilmington, North Carolina. The raw material is the leaves of needles of the long-leaved pine (*Pinus australis*), which also produces the turpentine of commerce. The particular process is said to be the invention of Mr. A. F. Scott. The exhibit includes a branch of pine, the gathered needles, and samples illustrating processes of cooking, rubbing, and carding. These are followed by the various products obtained, as pine hair, surgical dressing lint, pine oil, burlap, matting, and finally bagging. The bagging is especially adapted to the baling of cotton, and it is said that the Cotton Associations are perfectly satisfied with it. As the industry is new, a description of the processes of manufacture is deemed sufficiently interesting to give in detail.

The green pine straw or leaves, gathered in the surrounding forests, is brought to the mills, where the company purchases it at 15 cents per hundred pounds. After having been weighed, the straw is carried into a shed 100 by 25 feet and is spread upon the floor to be cleaned and to prevent it from becoming heated. An elevator takes it to the second floor of the building, where it is placed in two iron cylinders set up on end and surrounded by steam pipes. These extractors are 10 feet deep and about 4 feet in width. In these the pine leaves are thoroughly steamed, the vapor going through pipes into the ordinary distillery worm in an adjoining house. Here it is condensed. The result is the pine leaf oil, the leaves yielding about one half a gallon of oil to 100 pounds of straw. The oil is a valuable product, and is destined to take an important place in the advanced pharmacopœia. It is very highly antiseptic, possesses the advantage of being useful as well for internal as well as external application, and is valuable for many surgical and medicinal purposes. The liquid which is condensed from the vapor with the oils is useful for various purposes in the manufacture of other fabrics.

After the oil has been extracted the pine straw, which has become a beautiful black in color, is placed in six large iron vats, 7 feet wide, 8 feet long, and 5 deep, and with a capacity of holding 3,000 to 4,000 pounds each. It is here mixed with water and alkali, and thoroughly boiled, the process being necessary to remove the silica which forms the outside covering of the leaf. This is a difficult operation, requiring great skill and care. The silica which is removed is used for tanning and other purposes. During all this process of cooking the pine still retains its aroma. The last boiling process continues for twelve hours, after which the straw is soaked forty-eight hours more, and then it is ready for the machinery for rubbing up the leaves.

The straw taken from the vats and still-damp is first put into a "rubber," as it is called, and which consists of a number of cylindrical screws working together with both rotary and lateral motions.

The machine is quite complicated, and further description need not be given in this condensed account.

Suffice it to say that the straw being fed into it comes out of the other side a pure fiber of a rich dark-brown color and of a soft texture. During all these processes it is kept saturated with water, but it is next taken to the wringing and bleaching machine, where the water is squeezed out and the curing process is begun. It is then carried to the carding machine, through which it passes, and thence to the drying machine, where every particle of moisture is evaporated, and thence to the press, where it is put up in bales ready for market. The fiber is packed in burlap bales 225 pounds to a bale.

Aside from its use in the manufacture of carpets, matting, etc., the pine fiber has many other valuable qualities. A prominent Wilmington physician, to whom some of it was sent, writes as follows:

"The fiber made of pine straw is a most valuable agent in the treatment of simple and compound fracture, surgical dressing after operations and suppuration of wounds. It is superior to cotton-batting, lint, or oakum. Its aromatic odor drives away flies and prevents maggots from burrowing in wounds, and I think it is a disinfectant of the first order."

Apocynum cannabinum (Indian hemp).—An indigenous species of perennial herb, belonging to the dog-bane family, with upright branching stems 4 or 5 feet in length, having opposite leaves and a tough, reddish bark. This bark stripped from the stalks has been used by the North American Indians for a variety of uses, such as the rude manufacture of bags, mats, small ornamental baskets, boots, rope, twine, fish nets and lines, etc. It is easily separated from the stalk, and when cleaned it is quite fine, long, and tenacious. Its color is light cinnamon, though when finely prepared it is of a creamy white, and is remarkably fine and soft. The specimens in the fiber exhibit were taken from the collection of the Department of Agriculture, specimens of the seed pod accompanying the exhibit.

Asclepias.—This is a specimen of the "down" or seed vessels of the milkweed, which has been named, though wrongly, "vegetable silk." This silky substance, resembling thistle down, is produced in the pod of the plant, which, when ripe, bursts open and discharges its gossamer-like contents. The substance is of little value, unless for stuffing cushions, etc., although it has at different times attracted attention as a possible fiber material. This is the "silk plant," of which such fabulous stories are told from time to time. The milkweed or Asclepias produces a bast which furnishes a fine, long, glossy fiber that has considerable strength, and which has been ranked between hemp and flax.

Luffa cylindrica (the sponge cucumber).—The papinjay, and estrapajo of the Venezuelans. The fruit is from 6 inches to a foot in length, the interior being formed of a dense tissue of wiry fabrics, and containing three longitudinal tubes in which are found numerous black seeds. The cucumber after being stripped

of its outer integument becomes very soft and pliant when soaked in water, and is therefore used to take the place of the sponge in the toilet, or in the household economy is used as a cloth for washing dishes. In the South, ornamental baskets and even bonnets were made from it. In the specimens shown, one example is split open to show how it is prepared for these latter uses. Several cucumbers, cut to shape, are sewed together to produce the required article. The plant is common in South America and the West Indies. The specimens in the fiber collection were purchased in the open market, there being a slight demand for the product for toilet and other purposes.

Zea mays (maize, Indian corn).—An interesting specimen in the miscellaneous fibrous substances is a horse collar made from the husks of maize by a Georgia planter. These husk collars are quite common in the South, and are often woven by the colored people, who also make a little money from the weaving of door mats from the same substance. The husks are also used in their loose form for the manufacture of mattresses, there usually being several inches of husks, faced with curled hair. Husks have also been manufactured into paper, though it is not an industry.

It was intended to supplement the fiber collection with a full series of the paper-making materials, but lack of time in preparing the exhibits, and of space in placing them on exhibition precluded the proper carrying out of this part of the exhibit, and the idea was reluctantly abandoned.

CHAPTER XXVI.

TOBACCO IN THE UNITED STATES—ITS CULTURE, CHARACTERISTICS, DISTRIBUTION, AND CONSUMPTION.

By ALEX. McDONALD.

The very general use of tobacco in every quarter of the globe; the novel circumstances of its introduction into England and the continent of Europe, and its rapid spread in the face of persistent and even vindictive opposition; the fact that a seemingly noxious plant which possesses but little, if any, positive utility, and does not at all minister to the actual necessities of man, should supply one of the principal industries of the world and one of the largest staples of commerce; and, finally, the almost universal esteem in which it is held as a luxury and solace among all classes from peasant to prince, would seem to warrant a brief reference to the circumstances of its discovery and of its introduction among the principal nations of the earth.

The Name.—The common notion that the name *tobacco* was derived from its having been first brought from Tobago, a small island in the West Indies, is now admitted to be erroneous. The better authority is that the plant was not, in the first instance, called by this name, notwithstanding that Benzoni (whose Travels in America were published in 1565) says that the Mexican name of the herb was "tobacco." The term appears to have come from the name of the hollow tube used for inhaling the smoke of the plant by the inhabitants of Santo Domingo, and called by them "tobacco." This is confirmed by Humboldt, who states that "tobacco" was the term most used in the Haytian language to designate the instrument employed by the natives in smoking the herb; and that the term, having been transferred by the Spaniards from the pipe to the plant itself, has been adopted by other nations.

The botanical name of the genus, *Nicotiana*, was adopted, according to Linnæus, in recognition of the fact that Jean Nicot, the French embassador to Portugal, sent seeds of the plant to his queen, Catherine de Medici (in 1560).

Origin.—The Chinese claim to have possessed a knowledge of tobacco centuries before its introduction into Europe; and some modern writers give credence to this claim because of the supposed discovery on very ancient Chinese sculptures of figures representing tobacco pipes similar to those now in use. But it hardly admits of reasonable doubt that the plant was solely indigenous to America, and that it became known to the rest of the world through the discoverers and settlers of that continent.

A detachment of sailors sent by Columbus to the Island of Cuba on his first voyage saw the natives carrying lighted brands to kindle fire, and perfuming them-

selves with certain herbs. On his second voyage (1494) he observed the practice of snuff-taking. Eight years later (1502) the custom of tobacco-chewing was observed by the Spanish explorers on the coast of South America.

As the continent of North America was penetrated and appropriated by European adventurers and colonists it became apparent that tobacco-smoking was a universal and immemorial custom of the aborigines; and that, besides its narcotic and stimulating features it possesses a social as well as a sacred and cabalistic sanction. Among other uses the calumet or pipe of peace, was a symbol in the ratification of treaties; and smoking together—passing the pipe from one to another—was pledge of friendship, as the partaking of salt among certain Oriental nations. In the belief of the simple-minded children of the forest the "Great Spirit" smelled a sweet savor as the smoke of the sacred plant ascended to the heavens.

Introduction into Europe.—The high authority of the *Encyclopædia Britannica* supports the popular assertion that the tobacco plant was first brought to Europe, in 1558, by Francisco Fernandez, a physician sent out by Philip the Second of Spain to investigate the products of Mexico. But there is indisputable evidence that the seeds of the plant were brought to Spain more than thirty years before (1526) by *Gonzalo Hernandez Oviedo*, who spent several years in the island of St. Domingo. The plants from the seeds which he brought were at first regarded as simply ornamental; but the herb was afterwards cultivated for its supposed medicinal properties. It was regarded as possessing miraculous healing powers, and was designated "herba panacea," "herba sancta." The poet Spenser calls it "our holy herb Nicotian." It was brought to Italy from Spain in 1560, the same year in which, as above stated, Nicot introduced it into France.

While tobacco as an ornamental and medicinal plant was first known beyond the Atlantic through Spain, its smoking properties, in their apparently parodoxical use as a stimulant and a sedative, was introduced by the English many years later.

The familiar story that Sir Walter Raleigh introduced tobacco into England is not, strictly speaking, true. On his return from his voyage to America he appointed, by virtue of the large power granted in his patent from Elizabeth, Ralph Lane governor of the Virginia colony. After brief exercise of his prerogative this, the first governor of Virginia, returned, with the entire colony of 108 souls, to the mother country. During their sojourn in Virginia the colonists had acquired from the Indians the habit of smoking, and on their return (in 1586) they introduced among the English the tobacco plant and the custom of smoking its leaves. Sir Walter Raleigh eagerly adopted and extolled the new fashion, and "took a pipe of tobacco a little before he went to the scaffold." Through the example of this accomplished soldier, sailor, scholar, courtier, the custom became established among the nobles of Elizabeth's court and rapidly spread throughout the kingdom and in every commercial nation upon the Continent.

Although its use did not prevail to any considerable extent in the East until the succeeding century, the Turks and Persians are now the most confirmed smokers in the world; and in China and India smoking is habitual among all classes, all ages, and both sexes.

Attempts to Repress.—The rapid and world-wide spread of this plant is extraordinary and phenomenal when we consider that it fought its way into favor against the most strenuous efforts to repress it by both temporal and spiritual rulers. It encountered the shafts of ridicule and the weapons of persecution. Denunciations and diatribes were published in almost every principal language, notably the "Counterblasts to Tobacco" by James the First of England, in which its use is denounced as a "custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black stinking fume thereof nearest resembling the horrible Stygian smoke of the pit that is bottomless." Popes fulminated against it the anathemas of the church. In Russia the noses of smokers were

cut off, and in Turkey the pipes were thrust through this organ, and death in its most cruel forms inflicted upon the offenders. But all to no avail. The custom steadily increased until at the present day tobacco is more extensively and habitually used than any other narcotic or stimulant.

Botanical Description.—There are many—not less than fifty—species of *Nicotiana*, but those which supply the leaves used in tobacco smoking, chewing, and snuffing are few, and all except two are of American origin.

The various species may be ranged under two well-defined groups: one, the Virginia tobacco (*Nicotiana tobacum*), which has an unbranched cylindrical stem from 3 to 6 feet high, terminating in a pinnacle of pink flowers; the other, the green tobacco (*Nicotiana rustica*), originally a native of Brazil, has a branched stem from 2 to 5 feet high. These two types, together with the Persian tobacco (*Nicotiana persica*), are the sole source of commercial tobacco.

The Persian tobacco furnished the noted Tumbeki or Shiraz variety, but is limited in production. The green tobacco is said to have been the first variety introduced into England for cultivation, and is, in consequence, sometimes called English tobacco. Its cultivation is now chiefly confined to southern Germany, Hungary, and the East Indies.

The Virginia tobacco is the species from which are derived the tobaccos of Cuba, the United States, the Philippine Islands, and the Latakia of Turkey (grown in the northern part of Syria). It is thus not only the source of the greater proportion of the tobacco of commerce, but it is also the most highly prized and in its finer grades the most valuable of all the varieties. It is a native of the warm parts of America, but before the discovery of the New World by Columbus its cultivation had extended among the aboriginal tribes far to the north of the regions in which it was indigenous. It was introduced into Europe, and afterwards into Asia, from the colony of Virginia, and this section for two centuries furnished the great bulk of the tobacco of commerce for the world. A brief historical glance at the conditions of its culture in Virginia can hardly fail, therefore, to possess interest to the curious inquirer into its early production.

Its Culture in colonial Virginia.—On the first introduction of tobacco into England, in the latter part of the sixteenth century (1586) its use spread rapidly, and the high prices paid for it encouraged its active cultivation in the Virginia colony. Thirteen years after the first settlement occurred a circumstance which greatly stimulated its production, and has exercised a momentous influence upon the destiny of the American people. In the year 1620 a Dutch vessel entered the James River and sold 29 African slaves to the colonists. It was found that these slaves afforded a cheaper and more manageable labor than the "indented servants" from England, most of whom were paupers and convicts sent over and sold to the planters for a term of years to defray the expenses of their transportation. At the end of fifty years (1670) there were 2,000 negro slaves in the colony. The increase now became rapid, and in 1790 the census showed that there were 293,000. Under the stimulus of cheap labor the production of tobacco increased rapidly until in the year 1758 there was exported the enormous amount of 70,000,000 pounds, or 77,000 hogsheads of 900 pounds weight (the largest size then used). (See Tucker's Life of Jefferson.) This was a larger shipment than the average annual exportation from Virginia since that period. The industry was now well established, and the production of this staple as regular and uniform as at the present day. In these two centuries (from 1558 to 1758), during which the exportation of tobacco increased from the first small shipment to the large amount stated above, its cultivation, its preparation for market, and the regulations of its domestic and foreign traffic constituted the principal employment of the planter and the chief object of the fostering care of the colonial legislatures. The enactments of these legislatures, or burgesses, as they were called, and the proclamations and public acts of the colonial governors, were in 1823 compiled by Mr. Henning, the manuscripts of the earlier

acts having been furnished the compiler by Thomas Jefferson, to whom they were given by the son of Sir John Randolph, among whose papers they were found. (See Henning's Statutes at Large, Vol. I, p. 121.) This interesting manuscript is now in the Congressional Library at Washington. The first act but one provided that "whosoever shall absent himself from divine service any Sunday without an allowable excuse shall forfeit a pound of tobacco, and he that absenteth himself a month shall forfeit 50 pounds of tobacco." (*Idem*, p. 123.) It is enacted "that no man may dispose of any of his tobacco before the minister be satisfied." A levy is directed of 10 pounds of tobacco upon every male head "for defraying of such publique debts our troubles have brought upon us." (*Idem*, p. 128.) The importation of tobacco into England early became a source of the royal revenue, and the rapacity of James the First and his son Charles the First forbade, under severe penalties, the shipment of tobacco to any country except England. The latter monarch made a formal proposition to the colony for their exclusive trade in much the same language that one tradesman would use to another, and addressed interrogatories to the governor and burgesses touching the productions of the colony. The answer to this letter sets forth the injuries the planters had sustained by reason of the "monopoly of their tobacco in England," and proposes a contract with the King for all their tobacco at three shillings and sixpence per pound. (*Idem*, p. 134.) The field was a most inviting one, the revenue from the tobacco duties being enormous. In the reign of Charles the Second it reached the sum of $600,000, an amount larger than the entire revenue from customs at the close of Elizabeth's reign. (See Dodge's Statistics.) In 1628 there is a proclamation concerning "the plantings of tobacco," which prescribes the amount to be cultivated, the manner of planting and curing, and other details.

In 1629, and for several succeeding years, numerous acts were passed restricting the amount planted to from 1,000 to 2000 pounds to each man. This was deemed necessary on account of the low prices paid for the tobacco.

In 1630 it was enacted that no man should "make any bad or ill-conditioned tobacco or offer to pay away the same for debts or merchandise, on pain of having the same burned." (*Idem*, p. 152.)

In 1633 warehouses were for the first time established. Five of these, called "stores" in the act, were appointed, and the planters were directed to bring to them all of their tobacco in order that it might be "repacked, viewed, and tryed by sworne men appointed for that purpose," who should "cause all the badd and ill-conditioned tobaccos instantlie to be burnt, and the planters thereof to be disabled further from plantinge any more of that commodite of tobacco."

The warehouse system became henceforward an established institution. They were appointed to be built by the legislatures at convenient and designated places and inspectors appointed for them, who were required to give bond and take an oath for the faithful performance of their duties. Every pound of tobacco raised for the market was required to be brought to these warehouses before the last day of December in each year, and that which was found to be "trashy and ill-conditioned" was burned; the "good and merchantable was received." Receipts, formally drawn, were required to be given by the inspectors for all tobacco brought to the warehouses, which receipts had by law the property of promissory notes. They were made a legal tender, and, under the name of "tobacco notes," became the currency—and almost the sole currency—and medium of domestic traffic and the foundation of foreign exchange. All debts, public and private, were paid in them. (Henning's Statutes at Large, Vol. 4, pp. 251, 256.) This seems to have been made compulsory from public policy, in order, doubtless, to encourage its production, for a special act was passed permitting certain classes of persons who did not raise tobacco "to discharge all levies and officers' fees in money instead of tobacco." (Henning, Vol. 5, p. 168.)

Penalty of death was demanded against anyone who forged or who knowingly

used forged tobacco certificates or notes, and against inspectors who issued certificates for tobacco not actually in the warehouse. (Henning, Vol. 11, p. 242.)

Tobacco was thus the universal and potential commodity. It stood the planter in every stead. In 1619 ninety agreeable young women, "poor, but respectable and incorrupt, of virtuous education, handsome, and well recommended," were sent over as wives for the colonists by Sir Edward Sandys, treasurer of the Virginia Company, in London. They were sold to the young planters for 100 pounds of tobacco apiece. So well satisfied were the purchasers that when the next year another consignment of sixty young women was made, the value of the new commodity had risen in the market, and the price advanced to 150 pounds for a wife. (Howe's Hist. Virginia, p. 41.)

This reference to the unique conditions of the tobacco production in the colony of Virginia, the principal seat of its culture, for the first two centuries of its history, will be concluded with a few extracts from a paper of great interest as affording an illustration, at once amusing and melancholy, of the peculiar civilization which prevailed in the colony. In 1670 the lord commissioners of foreign plantations, in London, propounded a series of "Enquires" to the governor of Virginia, Sir William Berkeley. It may be found in the second volume of Henning's Statutes at Large (from page 508 to page 518), the compiler having (as in the case of the first acts of the colonial legislatures referred to above) obtained the manuscript from Thomas Jefferson, who purchased the only copy extant, taken from the confused records of the general court, formerly the secretary's office of the colony. In answer to an inquiry as to "what commodities are there of production," the governor says: "Commodities of the growth of our country we never had any but tobacco, which in this yet is considerable, that it yields His Majesty a great revenue." In answer to an inquiry as to the number of ships and their burthen that "do trade yearly to and from your plantation," the governor says: "English ships near eighty come out of England and Ireland every year for tobacco; few New England ketches." In answer to an inquiry as to the provision made "for instructing the people in the Christian religion, and for paying of your ministry," the governor says: "We have forty-eight parishes, and our ministers are well paid, and by my consent should be better *if they would pray oftener and preach less.*" * * * "But I thank God *there are no free schools* nor *printing*, and I hope we shall not have these hundred years; for *learning* has brought disobedience, and heresy, and sects into the world, and *printing* has divulged them, and libels against the best government. God keep us from both."

The Maryland Colony.—Next to Virginia the colony of Maryland entered upon the tobacco culture, and early in the eighteenth century she had attained some prominence in the export trade. In the year 1740 she exported 30,000 hogsheads. Following the example of Virginia, her legislature in 1732 made tobacco a legal tender in payment of debts, and a medium of exchange, both foreign and domestic.

Recent Distribution of the Crop.—Up to the middle of the last century the cultivation of tobacco was principally confined to Virginia and Maryland, the annual products of both colonies, at that time, amounting to between 50,000 and 60,000 hogsheads. The statistics show astonishing changes in the distribution of the crop in the last fifty years. The production of the eight principal States in 1840 was as follows (in round numbers):

State.	Pounds.	State.	Pounds.
Virginia	75,000,000	North Carolina	16,000,000
Kentucky	55,000,000	Missouri	9,000,000
Tennessee	29,000,000	Ohio	5,000,000
Maryland	24,000,000	Indiana	2,000,000

The next census (1850) shows still greater decline in the Virginia production, while Kentucky was closely contesting the precedence with her. The following was (in round numbers) the production of the nine principal States at that time:

State.	Pounds.	State.	Pounds.
Virginia	57,000,000	North Carolina	12,000,000
Kentucky	56,000,000	Ohio	10,000,000
Maryland	21,000,000	Connecticut	1,000,000
Tennessee	20,000,000	Indiana	1,000,000
Missouri	17,000,000		

These figures show that Virginia was barely maintaining precedence over Kentucky. Connecticut had entered the field in earnest, while Indiana had fallen behind her product of 1840. In the next census, however (1860), Indiana is returned as producing nearly 8,000,000 pounds, which quantity she has but little exceeded since.

The census returns of 1880 reversed the figures of preceding statistics, and exhibited the following condition of tobacco culture. The figures, as before, are in round numbers:

State.	Pounds.	State.	Pounds.
Kentucky	171,000,000	Missouri	12,000,000
Virginia	80,000,000	Wisconsin	11,000,000
Pennsylvania	37,000,000	Indiana	9,000,000
Ohio	35,000,000	New York	6,000,000
Tennessee	29,000,000	Massachusetts	5,000,000
North Carolina	27,000,000	Illinois	4,000,000
Maryland	26,000,000	West Virginia	2,000,000
Connecticut	14,000,000	Arkansas	1,000,000

The Producing Belt.—The belt including Virginia, Maryland, and Kentucky has from the first until the present day produced the larger proportion of the tobacco yield. In 1840 it produced 70 per cent of the whole; in 1850, 67 per cent; in 1860, 62 per cent; in 1870, 70 per cent; and in 1880, 60 per cent. But if we take the actual central tobacco belt, which, in addition to the three States named above, will include a slip from the northern portions of North Carolina and Tennessee, and the southern tier of counties in Ohio, Indiana, Illinois, and Missouri (all included between the thirty-sixth and thirty-ninth degrees of latitude), it will show the area which produces 99 per cent of the "shipping" and "manufacturing" tobacco of the United States (except the tobacco grown for cigar-making). The tobacco of manufacture and exportation is grown in the South; that for cigar-making, in the Northern States; very little of the latter being made south of Pennsylvania and Ohio, and nine-tenths of it north of Maryland and Kentucky. The heaviest rate of yield of the seed leaf or cigar tobacco, that is to say, the largest production in proportion to the area cultivated, is in the Connecticut Valley. (See Plates LIV and LV for view of growing crop and harvesting scene.)

The actual Area Cultivated.—While the tobacco for commercial and manufacturing purposes, of every description, is grown in fifteen States, the actual area thus utilized is astonishingly small, being computed to be equal, if compacted, to only about 33 miles square—the size of a large county. Upon this small area the average annual production is estimated at the enormous amount of 472,000,000 pounds. Less than half of this is used in home consumption (about 46 per cent); the larger part is exported. The tendency is to a relative increase in the home consumption, especially in the finer grades, and it is conjectured that the larger part of the better product will in the future find a home market.

Its Manufacture.—The industry of tobacco manufacturing consists of the various forms of manipulating and preparing for market the leaf of the plant. This indus-

TOBACCO—GROWING CROP.

HARVESTING TOBACCO.

try is divided into two branches, which the revenue laws of the United States require to be kept distinct and separate, as follows:

I. The manufacture of cigars and cigarettes, consuming about 30 per cent of the domestic leaf produced.

II. The manufacture of smoking and chewing tobacco and snuff. (Chewing tobacco consists of plug and fine cut.)

The ratio of increase in manufactures has been greater of recent years in the cigar and cigarette industry than in that of chewing, smoking, and snuffing. This may be seen by comparing the respective manufactures for the years 1870 and 1880, as follows:

	Pounds.
In 1870, quantity manufactured tobacco, estimated by the revenue returns (in round numbers)	90,000,000
In 1880, quantity manufactured, a little over	136,000,000
An increase of, say, 50 per cent over 1870.	
In 1870, cigars manufactured	1,139,470,774
cigarettes manufactured	13,881,417
Making together but little over	1,153,000,000
In 1880, cigars manufactured	2,367,803,248
cigarettes manufactured	408,708,366
Making together almost	2,876,000,000

Being nearly two and a half times as many as in 1870; and the relative increase has continued to swell in favor of cigars and cigarettes since 1880, particularly in the case of cigarettes.

The proportion used in the manufactured tobacco in the year 1880 were as follows:

	Pounds.
Plug chewing	89,806,801
Fine-cut chewing	17,362,181
Smoking	35,331,999
Snuff	3,977,224
Total	146,478,205

In addition to the domestic leaf embraced in the foregoing statistics of manufacture several millions of pounds of imported leaf are annually manufactured, an average of 8,000,000 pounds per annum for the decade preceding the census of 1880.

Varieties and Distribution.—The heavy tobacco, such as is grown in Virginia and Maryland, constituted until recent years the principal production of the country. Within the past thirty years the seed-leaf or cigar tobacco of Connecticut and Massachusetts has increased four-fold. The seed-leaf culture has been wonderfully stimulated in the two States named, and also in Pennsylvania, New York, Ohio, and Missouri, and to some extent in a few other States. Connecticut has held the foremost place in the seed-leaf production, though it is said to have deteriorated in that State in the last few years. The Connecticut leaf is of large size, light color, delicate fiber, and good flavor.

For some years the Pennsylvania seed-leaf, which is darker and coarser than the Connecticut, has grown in popularity, and now occupies the first position as to amount manufactured. That grown in Lancaster County is regarded as especially superior, and the yield is probably larger than that of the same variety (*i. e.*, seed-leaf) in any county in the United States.

The Ohio seed-leaf is considerable in quantity, and annually increasing, but it is not regarded as equal to that of Pennsylvania and Connecticut for manufacture. It is a dry tobacco, and on that account particularly suitable for exportation.

The disposition of the manufacturers seems to be to encourage the production of the fresh soil of the Western States as superior to that of the lands of the old States that have been for so many years subjected to this exhausting crop. That grown

in Wisconsin and Illinois is in particular demand. It is a small, delicate leaf resembling the Havana tobacco.

The Havana leaf is largely used in the cigar manufacture in the United States, for wrappers or exterior covers. A considerable quantity of tobacco is also grown in the United States from the seed of the Havana tobacco, and the product bears a strong resemblance to the Cuban leaf. The Department of Agriculture has annually distributed these seeds for cultivation, particularly in Connecticut, Massachusetts, New York, Pennsylvania, Wisconsin, Illinois, and Florida.

The bright tobacco grown in the southern part of Virginia, and more particularly in North Carolina, is in high repute, and enters largely into the cigarette manufacture. The famous bright leaf, varying in hue from lemon to mahogany, is there produced in perfection, and is in great demand for plug and smoking tobacco, and cigarettes.

Cigarettes.—The increase in the cigarette manufacture has been phenomenal. Between 1870 and 1880 it doubled in amount. The average annual increase during that decade was, approximately, 100,000,000. Since 1880 the increase has been even greater, the introduction of improved machinery for their manufacture having greatly stimulated the product.

Order of States in Tobacco Manufacture.—Virginia holds the first rank in the manufacture, taking all branches of the industry together, but she by no means maintains the same conspicuous precedence held by her for the first two centuries of the tobacco culture. Five-eighths of her crop is manufactured within her own borders, a larger proportion than is exhibited by any other State. The following is the order of precedence of States in the separate and also in the combined departments of tobacco manufacture, according to the last census:

Order.	In all products.	In cigars.	In plug and fine-cut.
1.	Virginia	New York	Virginia.
2.	New York	Pennsylvania	New Jersey
3.	New Jersey	Ohio	Missouri.
4.	Missouri	Illinois	New York.
5.	Ohio	California	North Carolina.
6.	North Carolina	Maryland	Ohio.
7.	Pennsylvania	Michigan	Illinois.
8.	Illinois	Massachusetts	Kentucky.
9.	Kentucky	Wisconsin	Maryland.
10.	Michigan	Missouri	Michigan.
11.	Maryland	New Jersey	Wisconsin.
12.	Wisconsin	Indiana	Pennsylvania.
13.	California	Florida	Louisiana.
14.	Louisiana	Louisiana	Delaware.
15.	Delaware	Kentucky	Massachusetts.

Perhaps the most notable fact in the above table is the position of New Jersey as the third State in the combined manufactures. The rapid development of this State has been principally in the plug-chewing manufacture. Missouri comes next to New Jersey, being the fourth State in the combined industry. The steady advance of Ohio in tobacco has also been conspicuous. That State is now fifth in the order of precedence in the combined industries, being third in cigar making, and sixth in plug and fine cut.

Cities that Manufacture.—The manufacture of tobacco is confined, of course, almost exclusively to cities and towns. The order in which the leading cities in this industry, in the United States, take precedence, according to the last census (in the combined branches of the manufacture), is as follows:

1. New York.
2. Richmond.
3. Jersey City.
4. St. Louis.
5. Lynchburg.
6. Petersburg.
7. Cincinnati.
8. Danville.
9. Louisville.
10. Brooklyn.
11. Chicago.
12. Baltimore.
13. Durham, N. C.
14. Detroit.
15. Philadelphia.

Snuff.—The tobacco best suited to the manufacture of snuff is the thick, fleshy leaf, of dark color. The finest American qualities are grown in Virginia, according to the authority of the Encyclopedia Britannica. According to the same authority none so good is grown anywhere except in Holland. The principal seat of the snuff manufacture is Wilmington, Delaware. A third of the American manufacture is confined to that city.

Where the Exports Go.—Tobacco is shipped from the United States to almost every country with which we have any traffic, though almost all of it goes to Europe. Since 1880 the tendency of exports has been to increase with France, Italy, and Spain, and to a relative falling off with Great Britain, Germany, and the Netherlands. The average annual amount of exports to these countries for the five years ending in 1886, was, in round numbers, as follows :

	Pounds.		Pounds.
Germany	50,000,000	Italy	29,000,000
Great Britain	45,000,000	Spain	24,000,000
France	32,000,000	Netherlands	16,000,000

Following is a brief description of the principal types, and their uses, of the leaf as shown and classified in the exhibit of the United States Agricultural Department.

Fancy Bright Leaf.—Designated "lemon and canary wrappers." This leaf is used exclusively for the outside covering, or "wrapper" for fine chewing tobacco manufactured into plug and fancy shapes. Its value varies according to color and texture, and from year to year according to supply in crops, generally ruling $60, $80, $100 for 100 pounds. It is largely consumed by Richmond, Virginia, manufacturers; but is used to some extent by Western manufacturers. It is produced to a limited extent in Virginia and West Virginia; but its principal production is in North Carolina, where it reaches its greatest perfection in point of delicate flavor. It is produced to a limited extent only as compared with other grades, and when properly grown and cured is a very remunerative crop to the planter. This is the tobacco referred to in this report as the "bright tobacco" grown in southern Virginia and in North Carolina.

Bright Leaf.—Designated "Bright Mahogany Wrapper." This leaf is used for the outside covering, or wrapper, for plug chewing tobacco. Much of it is used with the Burley filler, and other shapes, such as thin plug, twist, etc. It is consumed largely by Western manufacturers, and also by Virginia manufacturers to a large extent. Its value generally rules, according to color and quality, at $40 and $60 for the hundred pounds. It is raised in Virginia, West Virginia, and largely in North Carolina.

Dark Mahogany Leaf.—This is used in the manufacture of plug chewing, generally on 16-ounce plugs of Burley fillers, and is consumed very largely by manufacturers of the West, and also by Virginia and North Carolina manufacturers. Its value ranges generally from 35 to 40 cents per pound.

Dark Dapple Leaf.—This is used principally for dark plug work. It is grown principally in Virginia. Its market value is 25 and 35 cents per pound.

Fancy thin Bright Leaf.—This is similar to the "Fancy bright leaf" above, but lacks the gum and body, and is adapted to the cigarette manufacture, and it is used exclusively for that purpose, being consumed by manufacturers of North Carolina, Virginia, and New York. Its value is 30 to 45 cents per pound for the fine grades. It consists principally of the thin and more delicate leaves from the plant described above as "fancy bright leaf."

Black Leaf.—This is used as cover, or wrapper, for "Black Plug" work by the Virginia, North Carolina, and Western manufacturers. It is raised in Virginia and North Carolina. Value, 15 and 25 cents per pound.

Dark Mahogany Filler.—This is used generally by the Virginia and North Carolina manufacturers for plug work. It is raised in these States and its value from 10 to 20 cents per pound.

Dark Rich Leaf.—This is taken principally by the Austrian regie or administration. It is grown in several counties of middle Virginia and is marketed mainly in the cities of Lynchburg, Farmville, and Petersburg, in that State. It is rehandled in the loose state (as it comes from the planters) and shipped to the agent in Richmond. Its value ranges from 12 to 15 cents per pound, and for extra fine from 16 to 17 cents.

Bright Mahogany Filler.—This is consumed in plug work as far as it is used by Virginia and North Carolina manufacturers. It is used in the Dominion of Canada by the two principal manufacturers there and put up in plugs designed for house-smoking. It is grown in Virginia and North Carolina and is valued at 10 to 12½ cents per pound, and for finer grades 14, 18, and 20 cents.

Burley.—This is produced in Kentucky and marketed mainly in Louisville. It has grown rapidly in favor for manufacturing purposes because of its mild quality and great capacity for absorbing sweetening and water.

Seed Leaf.—This is used as wrappers, or covering, in cigar-making. It is produced in Connecticut, Massachusetts, Pennsylvania, New York, Ohio, and Wisconsin, and to some extent in some other States. It has been fully described in this report under the caption "Varieties and Distribution."

CHAPTER XXVII.

FORAGE PLANTS AND GRASSES OF THE UNITED STATES.

By GEORGE VASEY.

The forage plants of the United States consist, first, of native vegetation, mainly the grasses of certain treeless regions; second, of a few species, mostly foreign, of grasses and other plants which, since the settlement of the country, have become spontaneous over extended areas; and, third, of the forage plants of cultivation.

The native-grass districts of the country are comprised mainly in the tide-water marshes of the coast, the treeless fresh-water marshes of the wooded regions, the prairies proper and the plains.

Salt Marshes of the Seacoast.—The salt or tide-water marshes of most importance are those of the Atlantic coast. The area of these true salt marshes along the coast of New England is estimated by Prof. N. S. Shaler, of the United States Geological Survey, to exceed 200,000 acres. Less is known of their extent on other parts of the coast. They are found, however, throughout the coast regions.

Along the Gulf of Mexico they include much wet land covered with a dense growth of tall reeds and known as "cane breaks." These, though not harvested, furnish valuable winter forage for cattle. Along the upper Pacific coast are marshes similar to those of New England, which are cut to some extent for hay. The New England salt marshes owe their importance largely to their proximity to the great cities, which furnish a market for their product.

Salt hay is used not only as an inferior fodder for cattle and for bedding, but also for many other purposes, and is becoming more and more an article of trade. It is an excellent nonconductor of heat, and is used for protection from frost in winter.

Large quantities are used for covering ice. It is employed in packing mineral waters, bottled beer, and similar articles which it is desired to keep cool. Within a few years it has come into use among growers of small fruits as a mulch, especially for strawberries, serving both to keep the ground moist and to protect the berries from sand and mud. Salt hay is also largely used as packing material. One kind, called "Black grass" (*Juncus gerardi* Loisl.), is in special request for packing glass and other fragile wares. Salt hay contains a great variety of grasses and other plants, among the leading kinds being the *Juncus gerardi*, above mentioned, and *Spartina juncea.*

Fresh-water Marshes.—The term marsh is here applied to wet lands covered with grass, in distinction from swamp, which is applied to those bearing more or less timber. Marshes occur throughout the United States, but are most abundant in the region of the Great Lakes. Their formation is there favored, not only by an

abundant rainfall, but by a cool temperature, which is favorable to the growth of grasses and grass-like vegetation in extended areas. Here also glacial action has left numerous barriers which serve to retain the waters and permit the formation of swamps and marshes. Many of the marshes occupy the sites of ancient lakes, which in process of time have become filled with vegetable matter. Others are due to the work of beavers, which have dammed the streams at successive intervals, flooding large areas and killing the original timber. Others of less extent are due to local causes, including springs and the filling of lagoons along rivers.

All these marshes formed a valuable source of hay supply for the early settlers of the country, and in some localities they are still used for that purpose. When drained and brought under cultivation the marsh and swamp lands form the best of soil for the growth of timothy and other tame grasses, but are unsuitable for the growth of clover.

In the Southern States the wet lands are more generally covered with a wooded growth than at the North, and contain a smaller deposit of peat or muck. In some of the "savannas," however, there are open spaces covered with broomsedge, cane, and other coarse grasses which serve for pastures and are occasionally cut for hay.

The "flatwood" country of Florida, which is covered with water in the rainy season, furnishes during the dry season a growth of grass which serves as pasturage for cattle.

The Prairies.—The term prairie is applied to all dry lands which are naturally destitute of timber and covered with grass. The largest body of such land in the United States is situated between the wooded region of the East and the plains proper, which extend eastward from the base of the RockyMountains. It reaches in a broad, irregular belt from the western bend of the Gulf of Mexico northward across the entire country into the British Possessions.

The prairies comprise in all about 350,000 square miles, including the central half of Texas, the eastern portions of Kansas, Nebraska, and Dakota, and the southwestern portion of Minnesota and Wisconsin, the northern half of Illinois, and the greater part of Iowa.

Smaller areas of similar character also exist in neighboring States. Through the prairie region more or less timber is usually found along the streams, especially where the banks are hilly. In the northern half of the belt the prairies are less interrupted by timber than in the southern half. The heaviest growth of grass is found, as a rule, in the central portion, being shorter to the northward and less dense or continuous at the south.

The line of demarkation between the prairies and the plains is an arbitrary one, the grass becoming thinner and shorter and the timber along the streams more scanty as one goes westward. The prairies differ from other sections of the country mainly in the character of the vegetation, the surface being generally as uneven and the soil as varied as elsewhere. Continued deposits of vegetation have, however, produced over much of the surface a characteristic "prairie soil" of dark color, often several feet in depth.

The vegetation of the native prairies consists almost wholly of true grasses, a few shrubby plants, including *Ceanothus americanus* and *Amorpha canescens* being found mainly on the elevated lands.

The vegetation of the wettest swamps often consists wholly of species of Carex, or Juncus, but sometimes wholly of Reed grass (*Phragmites communis*). In the borders of ponds, or covering marshes which are not excessively wet, are dense growths of Cord grass (*Spartina cynosuroides*), or Wild Red Top (*Deyeuxia canadensis*). On the richer bottom lands *Panicum virgatum* abounds, and Blue-joint (*Andropogon provincialis*), the most highly valued of all prairie grasses. At higher levels grow Bushy Blue-stem (*Chrysopogon nutans*) and Bluff grass or small Blue-joint (*Andropogon scoparius*), while Bunch grass (*Sporobolus heterolepis*) often becomes the prevailing species

Prairie hay furnishes the largest supply of native hay in the country, being shipped in large amounts to distant markets. It is usually inferior to that of cultivated grasses, but its cheapness causes it to be extensively used. It is generally sold in two grades, upland and lowland, the former bringing the higher price. As the prairies are brought under cultivation timothy, clover, Kentucky blue-grass, and other well-known grasses of the Eastern States are introducd in place of native kinds.

The Plains.—West of the prairies proper there are no extended areas of native grasses that are cut for hay or suitable for that purpose. The grasses upon the plains are too small and too scanty to serve for more than pasture. Along the streams, especially in some of the mountain valleys, small tracts of land are found supporting a luxuriant growth of grass, which is sometimes cut to supply the cattle during severe winter weather. The grasses of the higher plains possess, owing to the dryness of the climate, the property of self-curing, so as to render them available for winter pasture. The fall of snow is here slight. and inclined to drift into the valleys, leaving the dried, nutritious grasses accessible at nearly all times. These "ranges" are now by far the most important native pasture lands of the United States, furnishing food for vast herds of cattle which supply beef not only to the markets of the country but also for export.

The amount of stock upon the ranges, however, is already in excess of the number that can be well supported. Excessive grazing has lessened the supply of grass, and anxious inquiries are now being made to discover means for increasing the supply of forage.

West of the plains proper lies the great interior desert region where the vegetation, except on some of the mountain slopes, is too scanty even for pasture.

LEADING FORAGE PLANTS OF THE UNITED STATES.

CULTIVATED GRASSES.

Timothy (*Phleum pratense* L.).—This is the leading hay grass of the United States, being the most largely and widely cultivated and bringing the highest price in market. It is especially valued as food for horses. Its cultivation is mainly confined, however, to the Northern and Eastern portions of the country, as it is not adapted to the extreme South or to the arid regions. For feeding cattle it is often grown mixed with clover.

Orchard Grass (*Dactylis glomerata* L.).—This grass, although well known to be a valuable one for meadows and for pastures, and widely cultivated in Europe and Asia, has only recently come to be much used in this country. It is best adapted to a moist, heavy soil, and grows well also in shaded ground. It is to some extent used as a meadow grass, but where natural pastures have been replaced by artificial ones orchard grass has been most largely employed. It is of rapid growth, stands drought well, and grows best when closely cropped, but especially in the spring and fall.

Red-top (*Agrostis vulgaris* With.).—Red-top has become thoroughly naturalized throughout the cultivated portions of the United States. It furnishes in moist meadows a hay of fine texture, considered excellent for cattle. The yield is less than that produced by the same area of timothy. In pastures it furnishes good grazing early in the season, but later it becomes wiry and unpalatable. It does good service, also, by filling in the thin spots in meadows of other grasses.

Fowl Meadow-grass (*Poa serotina* Ehrh.).—This grass is well adapted to moist lands, where it produces a large amount of fine, nutritious, palatable hay. It has not been cultivated over large areas, but is mainly used for low places in meadows, where other grasses do not succeed. Fowl Meadow-grass is becoming spontaneous in the West, even on rich upland soils.

Hungarian Grass (*Setaria italica* Kunth.).—This is an annual grass, growing only under cultivation, which produces a very heavy crop, valuable, if cut early, for green fodder. The whole plant is then tender and succulent. It is also cured for hay, and grown considerably for that purpose in the Eastern States, being mainly used when the ordinary hay crops fail.

Johnson Grass (*Sorghum halepense* Pers.).—This has been cultivated in different parts of the country under several distinct names, but it is most widely known as Johnson grass. It was introduced into the United States from Turkey about the year 1835, but it has come into general notice only within the last few years. It now promises to be the mainstay, so far as forage is concerned, of cattle raisers in the Southern States, and it seems likely to succeed on some, at least, of the arid Western plains, where the winters are not too severe. It grows commonly 5 to 6 feet high, from strong, running rootstocks. Three cuttings are usually made during the season, and the aftermath is used for grazing. Ordinarily, to start a field, the seed is sown, and as soon as a vigorous growth is established, the open places are filled in by transplanting rootstocks from thicker areas. A field once planted is indestructible, and its capability for withstanding drought and of growing on soil of only average richness adapts it still better to the South and Southwest.

Kentucky Blue-grass (*Poa pratensis* L.).—Of all our native grasses this is one of the most widely disseminated, and for pasture is the most valuable grass known. It is indigenous in our mountain regions, but has become naturalized throughout the country. It is grown in meadows to some extent in the Eastern States, under the name of June grass, forming an excellent early crop; and in all rich pastures it forms the chief part. Like timothy and orchard grass, it grows well only on rich soil, and it does not withstand a severe drought.

Texas Blue-grass (*Poa arachnifera* Torr.).—A grass only recently brought to the notice of agriculturists, but giving promise of excellent results. It is indigenous to the prairie regions of the Southwest, from New Mexico to Texas, frequently forming large natural pastures. Its texture and nutritive properties are similar to those of Kentucky blue grass, and it forms a heavier growth, and an even firmer sod. Its especially commendable characteristic is its winter growth, for in its native climate, and in those Southern States east of the Mississippi, where it has been tried, it begins its growth in August or September, and continues it until the time of its seeding in April, thus supplying a great desideratum in the South, a grass for winter grazing.

Texas Millet (*Panicum texanum* Buckley).—This is a native of Texas which has already earned for itself a high position among our valuable grasses. It is an annual, growing ordinarily to the height of from 2 to 4 feet, succulent, and producing a heavy crop, affording two or three cuttings in a season. It has little value as a grazing plant, as it is an annual, but the hay produced is of excellent quality. An especially valuable feature of this grass is that it seeds itself spontaneously and effectively, and is not subdued by any weed, except, in some cases, crab-grass; and so abundantly are the seeds distributed in some of the localities in which it has been cultivated that a good meadow of it may be started by simply plowing a grain field and allowing it to grow up without seeding.

Indian Corn (*Zea mays* L.).—In many parts of New York, Pennsylvania, and the New England States, in which the land is valuable and large pasturage areas can not be afforded, Indian corn is largely employed in midsummer as green fodder. It is usually sowed either broadcast or in close drills, so that the plants grow weak and succulent, seldom ripening ears. It is also the main ensilage crop, and when raised for this purpose is sowed thinner, so that the ears mature, and the whole plant is used. In all parts of the country in which corn is grown, the stalks, after the harvesting of the crop, are generally saved for fodder, furnishing valuable food for cattle, but seldom given to horses.

OTHER CULTIVATED FORAGE PLANTS.

The Clover.—Mammoth clover (*Trifolium medium* L), *Medium clover* (*T. pratense* L.), and *Alsike clover* (*T. Hybridum* L.), *White clover* (*T. repens* L.).—The first two of these give in rich soil a luxuriant, heavy growth, which makes excellent hay for cattle, especially if cut early, and furnishes an after-growth valuable for pasture. These species are also used to some extent here, as in Europe, for soiling. Alsike has not been so extensively cultivated as the other kinds, but is thought to make a better quality of hay. All three are commonly used mixed with timothy, and in that way form a very considerable portion of our best hay. White clover is seldom cultivated for hay, but mixed with orchard grass and Kentucky blue grass is much used in pastures.

Cow-peas (*Dolichos sinensis* L.).—The Cow-pea is extensively cultivated in the Southern States, taking there the place of the clovers at the North. There are many varieties in cultivation, adapted to the somewhat different soils and needs. When the seeds are partly grown, the plant makes a nutritious hay, and stock thrive well upon it. It will grow upon almost any kind of soil, and is not easily affected by drought.

Alfalfa (*Medicago sativa* L.).—This is the plant known in Europe as lucerne. It was introduced into California several years ago from South America, and has proved remarkably successful there. It has long been known in the Eastern States, but did not supply any especial need. In the Southern States, however, where it is beginning to be extensively cultivated, it is found well adapted to the climate, and on rich, sandy soils produces a heavy crop of excellent hay. It is not successful as a pasture plant, for it is rather easily trodden out, and when eaten green in large quantities sometimes causes death.

SPONTANEOUS FORAGE PLANTS.

Bermuda grass (*Cynodon dactylon* Pers.).—This grass was many years ago introduced into the United States, but being considered a troublesome weed, its dissemination was checked as much as possible. It continued to spread in the Southern States, however, being propagated mostly by the rootstocks, and has been found to possess valuable properties. It grows best under a hot sun, only a severe drought affecting it. It forms a close, matted sod, the stems rising to a height of about 9 inches; and in every way it is adapted to Southern requirements as a pasture grass. On account of its small size it is seldom cut for hay.

Kentucky Blue-grass (*Poa pratensis* L.).—An account of this grass has already been given under "Cultivated Grasses." But it is to be borne in mind that in the natural pastures, especially in rich soil, of all except the Southern States, Kentucky blue grass forms the main and most reliable part.

Crab Grass (*Panicum sanguinale* L.).—Crab grass is known throughout the United States, especially in the South, as a very troublesome weed in cultivated grounds. It thrives best under the same conditions and in the same soils as Bermuda grass, growing to the height of about 1½ feet. Thus far it has been used mainly for hay, being allowed to grow after the regular crops for the year have been removed. Being an annual, it does not make a permanent meadow or pasture.

Alfilaria (*Erodium cicutarium* L Her.).—This plant, a troublesome weed in Europe, and occasionally met with in the Eastern United States, has taken a thorough footing in California on lands too dry for most forage grasses. It attains frequently a height of 2 feet, and furnishes in its green state and in the early part of summer most excellent pasturage. The hay, occasionally made from it, is nearly worthless, as it is brittle and crumbly. The plant seeds itself abundantly; but, as it is an annual, it furnishes no pasturage late in the season.

Bur Clover (*Medicago denticulata* Willd., and to some extent also *M. maculata*

Willd.).—In California Bur clover performs much the same office as does alfilaria. It is an annual, producing a good amount of early pasturage, but dying when dry weather comes. The ripened seeds, which remain in the dead stalks, furnish nutritious food, and coming at a time when other pasturage is almost entirely wanting, prove very valuable to California stock-raisers. Bur clover occurs to some extent in the Southern States, but it is little needed and little used there.

Japan Clover (*Lespedeza striata* Hook. and Arn.).—This plant, an annual, was introduced into the Southern States about 40 years ago from China, and has now become abundant on all the grazing lands throughout the Gulf States. It grows on almost any soil, in pine barrens, rising only to a height of 5 or 6 inches. In rich soil it attains a height of 1½ feet, and makes a good hay crop. It withstands drought well, but is killed by the first frost. This plant and Bermuda grass have proved a godsend to those portions of the South in which natural pasturage is relied upon for the support of stock.

In addition to these widely distributed grasses and forage plants there are many others that form an important part of the natural forage product in areas not yet brought under cultivation. In the salt marshes of the eastern coast black grass (*Juncus gerardi* Loisel.) and salt grass proper (*Spartina juncea* Willd.) form the main part of the salt hay of commerce. In such fresh-water marshes as produce any forage at all the principal part is made up of coarse sedges (mostly of the genus *Carex*), while a large number of grasses, and other plants in less abundance individually, usually add much to the common mass. Farther west the proportion of grasses is larger, and the rushes, particularly *Juncus nodosus* L., are also much more abundant.

Of the true prairie land of the West comparatively little is now left in its original condition, but large areas of half-arid prairies still remain unimproved and are used for grazing. Buffalo grass (*Buchloë dactyloides* Engl.) and Gramma grass (*Bouteloua oligostachya* Torr.) are among the best of the widely distributed species. Besides these, certain species of *Festuca*, *Deyeuxia*, *Sporobolus*, *Andropogon*, *Agropyrum*, and *Elymus* make up a large part of the nutritive grasses of these areas.

In some parts of the Southwest the Prickly Pear (*Opuntia engelmanni* Salm.) and other species of cactus are much used. Before the plants are fed, the spines are ordinarily scorched off.

In California the Wild Oat (*Avena fatua* L.) makes an important addition to the introduced Alfilaria and Bur clover.

HAYMAKING.

The cheapness of land in the United States encourages the production of hay on a larger scale than in the countries of Europe. The climate, also, on the whole, is exceptionally favorable for the curing of hay. These facts, together with the inventive spirit of the people, have led to the use of machinery for the making and handling of hay to a larger extent than has been known at any other time or in any other country. Nearly five thousand patents have been granted for inventions in machinery used for these purposes. Of these patents over one thousand are for mowers, four hundred for hay loaders, over five hundred for horse hayforks, and nearly one thousand for horse hayrakes.

Notwithstanding the high price of labor in the United States, this improved machinery enables contracts for cutting, gathering and stacking of hay to be let in some of the Western prairie regions at as low a price as $1 per ton.

The time allowed for the preparation of this report does not permit a full account of American methods of hay-making and of the machinery employed for the purpose, but a collection of photographs of hay scenes, and of hay machinery in operation, will be found accompanying the exhibit. (See Plates LVI-LVIII.) The exhibition of the hay machinery itself is made by the manufacturers, and not by the Governmnt.

HAY-PRESS RUN BY STEAM (IOWA).

LOADING HAY FROM WINDROW (IOWA).

STACKING HAY NEAR AMES, IOWA.

HAY EXHIBIT.

About fifty bales of the leading native and cultivated forage plants of the country were collected. Owing to the limited space, only a portion were shown in the form of bales, the remainder being exhibited in glazed boxes. The samples were obtained, as a rule, from those parts of the country where most largely grown, or where they are of leading importance. For example, timothy from Michigan, clover from New York, Hungarian grass from Ohio, Alfalfa from Colorado, Cowpeas from Georgia, Japan clover from Alabama, Crab-grass from Mississippi, Bermuda grass from Louisiana, Texas millet and Texas Blue-grass from Texas, prairie grasses from Iowa and Kansas, Alfilaria and Bur clover from California, etc.

A full list of the exhibit will be found in the catalogue, and a description of the various kinds and their value is given elsewhere in this report.

ENSILAGE EXHIBIT.

A small exhibit of ensilage is made in glass jars, one series sealed, showing the ensilage in the fresh state as taken from the silo; another series consisting of samples which have been evaporated, to prevent discoloration upon exposure to the air, and to render them convenient to handle.

The use of ensilage in the United States is increasing, but neither its manufacture, nor the method of feeding it, can be said yet to have passed the experimental stage.

Within a few years the use of subterranean stone silos has been giving place to those of cheaper construction made above ground. The practice of heavily weighting the contents has also been generally discontinued, they being merely closely covered to exclude air, and subjected to a moderate pressure from a covering of coarse hay or straw. The necessity for the use of ensilage is not as great in the United States as in Europe, owing to the cheapness of land and the certainty with which hay can be cured; but, on the other hand, the availability of the great staple crop, Indian corn, for the purpose of ensilage, has led to a much larger use of that system than would otherwise have been the case.

Various other crops, however, are employed for this purpose, especially varieties of sorghum or Chinese sugar cane.

Ensilage is not usually fed alone, but in connection with hay or straw. It is considered especially valuable for milch cows, not only in winter, but during droughts in summer, and recent experiments in feeding ensilage with Indian meal seem to indicate that it is well adapted for fattening animals.

CHAPTER XXVIII.

THE IMPROVED SILO AND ENSILAGE.

By HERBERT MYRICK.

No innovation in American agriculture has ever made more rapid progress than the system of preserving green fodder in silos. The improvements which have been made in this system are also characteristic of the American genius for bettering and simplifying the inventions of others. The ensilage system, as a practical reality, is hardly ten years old in the United States; yet, according to the best authentic data, there are upward of 7,000 silos in the country. They are found in every State and Territory, but most largely in the dairy regions. The first silos were expensive structures, built of stone and cement. The work of cheapening and simplifying them has been going on until to-day the silo, popularly adopted throughout a large portion of the Middle and Western States, is built entirely of wood.

The model exhibited shows plainly how these silos are constructed. The silo is usually twice as long as it is wide. The greater the depth the better, as the greater will be the settling weight of the ensilage. A silo may be built in a barn or other building on the same principle as that shown in the model; but, of course, if in such a building, will not require a separate roof. If built in a barn, it should be entirely independent of that structure, having its own framework, although the studding need not be as heavy as for a separate outside structure. Avoid endeavoring to make use of both wood and stone in silo-building. The object is to make air-tight walls, and this can not be done by trying to unite wood and stone. If a stone wall extends under a barn, let the scantling for the silo go down inside of it to the ground, and so leave an air space between the stone wall and the silo lining.

It is well to place the foundations of the structure deep enough to avoid heaving by frost. The foundations may also rise 6 inches or a foot above the surface of the level ground about it, although this is not absolutely essential. Brick or stone may be used, or concrete in the foundation. The soil should be excavated from the floor to the depth of 1 foot over the entire area, including the outside measurement of the walls. Formerly expensive concrete floors were put in, but these have very little superiority over clay well pounded down and allowed to come up a few inches on the inside of the silo walls. Of course the silo should be located where there is as perfect drainage as possible, so that the ensilage will not be injured by a surplus of water.

Many silos are built, however, without this stone foundation. The soil is excavated to the depth of 1 foot over an area larger than the outside measurement of the walls. A trench is then sunk just inside this excavation, in which cement or grout is placed to the depth of 3 or 4 inches. In this mixture is bedded the sill, a

by 8 inches in size. To prevent the building from spreading, cross sills are framed into the main sills. The studding is mortised solidly into the sill, and the silo is lined up inside with two thicknesses of inch boards, 8 by 12 inches in width, breaking joints with a half lap. Between these boards tarred paper is placed, the three being strongly nailed to the studding. Spreading at the base will also be prevented by having the corners well tied together. Instead of using square timbers, which are greatly weakened by cutting, plank may be substituted for the sills, and the corners constructed by laying one plank over the other. If these are well spiked there will be no danger of spreading. These planks should be at least 8 inches wide, while 10 inches are better, and the planks should be 2 inches thick. Where such plank are used, four, lying one on top of another, make a sill 8 inches thick. Even with this sill, cross sills will be necessary. If possible, the sills should be as wide as the wall upon which they rest. At least, the sills should be flush with the finished wall; otherwise the ensilage, spreading on the shoulder made by the jutting wall, is almost certain to spoil at that point. The studding should be 2 by 8, or 2 by 10 inches in size, and should stand not farther apart than every 16 inches. Particular attention is directed to the way in which the studding are attached at the top and to the construction of the roof (see model), which is braced in a manner to insure the strength of the building, and yet not interfere with machinery and filling the silo. The ensilage carrier ususally runs across the silo directly under the roof; hence the necessity of having this space as free from cross timbers as possible. At the same time the top must be thoroughly braced to prevent the building spreading.

The inside of the silo is made of two thicknesses of inch board, dressed or planed on one side. Care should be taken not to use too wide boards, as they will swell and bulge. Have the studding set up every 16 inches; some advocate first tacking on building paper. Caution should be exercised in measuring the building paper carefully before setting up the studding, as it is sometimes scant in width and trouble will occur when one attempts to tack on the paper. Run the strips of building paper up and down and have them catch on every third studding; avoid all openings or rents in the paper. The boards should be nailed on smooth side out. When the first boarding has been completed some farmers cover again with building paper before placing the second layer of boards over the first. Be careful to break joints in putting on the second layer of boards, as shown in model. Common lumber will do for this purpose, as it will swell up and keep tight. Care should be taken to make the corners of the siding fit as snugly as possible. The corner post should also be double, as shown in the model. The way in which the inside lining boards make a tight corner is shown better in the model than it can be explained here, and is illustrated in the two top boards of the model. This construction adds greatly to the strength of the silo.

Upon the outside of the studding tack building paper again, as was first done on the inside. Over this paper place any kind of boards desired, but it is best to have some matched stuff or siding that breaks corners, as shown in the model.

It will be seen, therefore, that the walls are constructed as follows, beginning at the outside: First, siding; second, building paper; third, a dead-air space of 8 or 10 inches; fourth, building paper; fifth, common boards; sixth, building paper; seventh, common boards. The second and sixth items, both building paper, are often omitted, as they are in the model, and many experts believe the single thickness of paper between the inside boarding makes the most perfect silo. If it is desired to cheapen the silo by doing away with one papering, omit one of the inside linings of building paper rather than the outside lining. No sawdust, tanbark, or other filling should be used, as a dead-air space is a better non-conductor for the silo and less expensive than anything it can be filled with.

To prevent lateral pressure, especially on quite a high silo, two iron rods should

be run through the partition walls joining the side of the building, about in its middle, placing one about 2 feet above the partition sill, and the other about 4 feet above that. Half or three-fourths inch rods, with heavy caps at the end, should be sufficient and are easily put in place before the boards are tacked to the partition through which the rods run, so as not to be in the way, provided a permanent partition is built.

Usually, however, a loose solid plank partition is preferred. The construction of both kinds is shown in the model. The sliding partition is made with 2-inch plank, with rounded edges, which work in the groove. As the filling of the silo advances, the planks are added as required, until the top is reached. When feeding, the ensilage from the first pit is taken, then the cover from the next pit is removed, and as the feeding uses up the ensilage, the planks are taken off one by one. The solid partition is usually built of 2 by 4 scantling, sheathed up with common boards. The sliding plank can be pinned into place if desired. The model shows the roof constructed without any plate over the siding, the roof trusses being spiked directly to the top of each studding. The under cross-ties, 1 by 8 inches in size, are nailed strongly to the opposite side of the studding.

The contents of a silo may be roughly estimated by allowing that each cubic foot of space will hold from 35 to 40 pounds of settled ensilage. We formerly estimated 50 pounds to the cubic foot, but repeated weighings show that 35 to 40 pounds are an outside limit for well-settled corn (maize) ensilage cut into lengths of about half an inch. It is therefore safe to calculate that each 50 cubic feet will contain one ton of well-settled corn ensilage, while one ton of hay will occupy 300 to 500 cubic feet. One cubic foot of corn ensilage contains from 7½ to 8 pounds of actual dry matter or real nutriment, while a cubic foot of hay contains only 4 to 4½ pounds of dry matter. Therefore "twice as much dry matter or actual food can be stored in a given space in the shape of ensilage as in the form of hay."

Cost of the Silo.—This will vary from 50 cents per ton of ensilage content to $2.50 per ton. A good wooden silo should not cost as much as a good barn. As the silo will preserve in a given space in the form of ensilage twice as much food as the barn, the economy of the silo on this score is well settled. Accurate data on the cost of handling ensilage from the field to the manger, compared with the cost of handling the corn fodder by dry curing, are yet wanting, though the weight of testimony is that it certainly does not cost any more to handle 100 pounds of actual dry matter in the ensilage system than the same quantity of food in dry-cured corn fodder. But it is proven that, if the corn is cut when well matured, the loss of food ingredients is greater in curing than by the ensilage system. Moreover (see Wis. Exp. Sta. 5th rep., p. 26), "while we know of no way to improve on the method employed for drying and storing fodder as now practiced by the best farmers, it is probable that we can materially lessen the losses occurring in the silo in the future by improved practice." The same authority combines much practical experience in these conclusions:

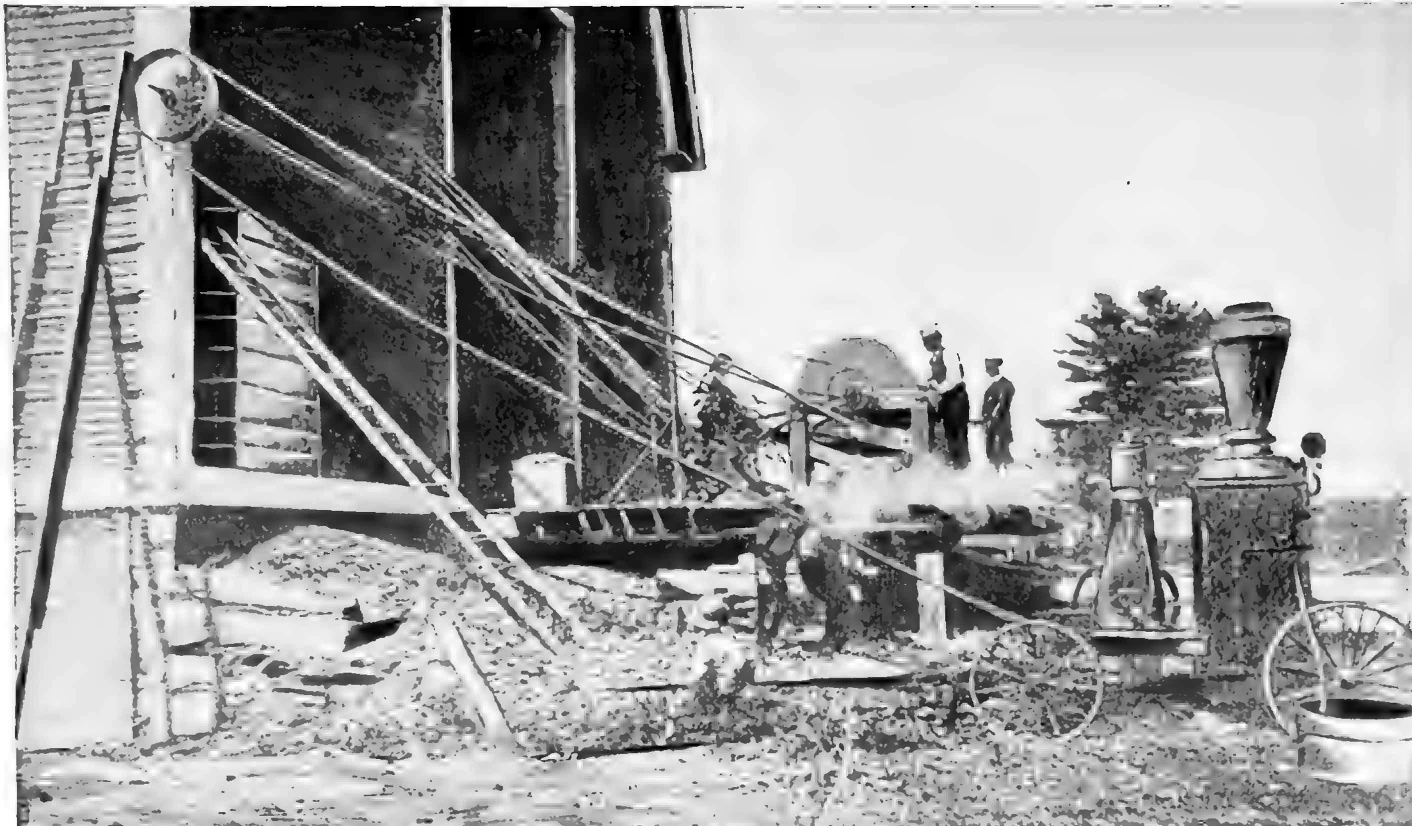
"Dairy cows readily consume a sufficient quantity of corn ensilage to maintain a flow of milk and yield of butter fully equal to and rather more than that produced by feeding dry fodder corn. The dry matter of corn ensilage has not shown a higher feeding value than the dry matter of carefully cured fodder corn. Long ensilage will go nearly twice as far in feeding cows as long fodder, when large varieties of corn are used."

Culture and Harvesting.—Rich soil is required to produce 20 tons or more per acre of green fodder of ensilage containing not over 75 per cent of dry matter. The seed is planted in drills 3 to 3½ feet apart and thinly enough (2 to 5 inches apart) in the drills so that the stalks will each perfect an ear of sound grain. The expense of culture averages 50 cents per ton of ensilage, when grown on a considerable scale, and the cost of harvesting is at least $1 per ton. Add charges for manure,

use of land, etc., and the total cost per ton will be at least $2, and may run up as high as $5 on a small scale, even with a fair yield. The practice is growing of putting in the silo the whole crop of common field corn, ears and all, thus making but one job more of the whole work of harvesting the fodder or plucking the ears, husking, grinding, etc. This practice is quite satisfactory. Many silos are also being filled with uncut corn fodder. The crop is cut up close to the ground and placed directly in the silo, butts and tops end for end, to pack solidly. Such "whole ensilage" keeps well, but has to be cut with a broadax or hay knife when fed, and is not eaten quite as closely as the fine-cut ensilage. The silo of which we show a model would need to be modified for "whole ensilage," so that the wagons loaded with the long forage could drive up to the top and dump in their contents without lifting.

Harvesting.—Usually the ensilage corn is cut up at the bottom, brought to the silo, and fed into a cutting machine run by steam power. This chops it into half-inch or five-eighths-inch lengths, and by an elevator attachment conveys the cut corn up into the top of the silo through the window in the roof (or end), and when one compartment is filled the next one is filled. The filled silo is then covered with thick building paper or a foot or two deep of coarse hay or straw. Many farmers still employ heavy pressure on ensilage, but no weight is now used for these improved silos, nor is the waste by rot as much with the covering described as with an air-tight and heavily weighted cover. Some farmers do not even use the paper, but tread down a good layer of not very dry hay, tucking it in about the walls very carefully with a spade, letting the ensilage heat before putting on this covering. Of course the ensilage should be well trodden down as the filling process goes on.

Taking out the Ensilage.—When it is designed to open the silo, begin at the end near the door. Dig down to the door, take off a couple of the top plank, and pitch the ensilage through this aperture into the wagon or conveyance that is to take it to the cattle. Arrange the silo so that this work of feeding will be as small as possible. (Plate LIX represents ensilage cutting at the College of Agriculture and Mechanical Arts of New Hampshire.)



ENSILAGE CUTTING, COLLEGE OF AGRICULTURE AND MECHANICAL ARTS OF NEW HAMPSHIRE.

CHAPTER XXIX.

FORESTRY IN THE UNITED STATES.

By B. E. FERNOW.

Forestry is a branch of economics hardly known or practiced in the United States, if by the term we designate the art of managing and reproducing forests as it is understood and practiced in Europe.

It is only within the last decade or two that the eventual need of a more economical working of the virgin timber growth has been recognized, and that on the treeless plains of the West, tree planting, hardly forest planting, for the sake of climatic amelioration has been practiced. Only here and there in the Eastern States, on the prairies, and in California, are small plantations or groves of planted forest to be found; but forest management applied to natural forests is not known to exist anywhere.

The necessity for the application of forest management and forest growing, however, is rapidly becoming more evident, and a system of forestry adapted to American conditions, political, climatical, and floral, is gradually taking shape.

Under such circumstances a forestry exhibit can show but little more than existing conditions and composition of the natural forests, and the methods employed in their utilization. Forestry proper can not be represented by plans, maps, etc., in detail, as no system of forest management exists and no working plans have been even thought of.

Since the time for securing the exhibits was extremely short, hardly more than three months, and that, moreover, late in the fall of the year after the fall of leaves, the task was a difficult one with regard to botanical specimens. The herbarium of the forestry division had only been started one season, and was barely in condition to furnish representative specimens even of the commoner species. Notwithstanding the difficulties, to which must be added scant appropriations and limited space, the exhibit will at least afford opportunity to the beholder to improve his acquaintance with our forest resources.

The main object of the exhibit has been to so classify and arrange objects within a compact space that a systematic study would be possible. With the limited space at disposal it was thought best to exclude wood manufactures of which it would have been impossible to present an exhaustive display, their variety and extent in the United States being enormous, and by adhering closely to such exhibits as bear directly upon forest products and forestry proper, a more or less organized whole could be represented.

The exhibit has been classified into three subsections, namely: Subsection A, forest botany; subsection B, forest culture; subsection C, forest utilization. To avoid

further subdivision, it has been necessary to bring into one of these subsections parts of the exhibit which might otherwise call for further classification.

FOREST BOTANY.

The variety of economically useful timber trees which compose the forest growth of the United States of America, is hardly, if at all, equaled anywhere in the world.

Of the 412 or more arborescent species which are now known to occur within the limits of the United States, not less than 160 may be counted as economically valuable trees, worthy of attention, with a range of qualities from the soft and light texture of the poplars and magnolias to the hard and strong fibers of the hickory and osage orange, furnishing material for almost every conceivable use.

The range of climatic differences from the Atlantic to the Pacific Ocean and from the Canadian boundary to within 25 degrees of the equator, is such as to account for this diversity. It should, however, be stated that 64 or 65 species are of semitropical origin, importations from the West Indies, and found only along the southern coast and keys of Florida in small quantities. These, for the present at least, the forester may at once dismiss from his consideration. Another similar exclusion may for the present be made of some species which overlap from the Mexican flora, some 26 or 27, with but a confined distribution in the United States. There remain then about 320 species which call for a discriminating classification by the forester, and if we exclude all species, which as a rule, do not exceed 1 foot in diameter, we decrease this number again, to, say 235 species, which possibly may enter into the consideration of forest managment

Leaving out of consideration the semitropical woods of Florida and the north Mexican flora, we can divide the forest growth into two great natural or forest botanical divisions, namely : The Atlantic Region, which reaches from the Atlantic coast to the eastern base of the Rocky Mountains ; and the Pacific Region, which occupies the territory west of the eastern base of the Rocky Mountains, the two regions being quite different in forestal character as well as in configuration. On the Pacific slope, with higher elevations and mountain ranges, coniferous growth is prevalent ; on the Atlantic, with lower levels, plains, and prairies, the deciduous growth is more prominent.

There are but few species which occur in both regions overlapping from one into the other, and fewer still which occupy large territories in both. Of the latter there are but 10, principally belonging to the Northern forest. There are 15 Atlantic species overlapping into the Pacific region, mostly in the Southern range,

Exhibit I.—A further discrimination of types of forest flora leads to the geographical division exhibited in map No. 1, showing the natural divisions of North American forests. (From the work of Prof. Sargent in the Tenth Census, 1880.)

The characteristic trees in each division may be named as follows :

Northern Division (with 8 arborescent species) : White and black spruces, poplars, birches, willows. Northern pine division : White pine, hemlock, sugar maple, linden, elm. Deciduous forests of the Mississippi Basin and Atlantic plains : Oaks, hickories, walnuts, ashes, chestnut, tulip trees. Southern coast plain : Long-leaf pine, taxodium, magnolias, live oak, gums.

Semitropical forest of Florida : Mahogany, palm, mangrove. Northern Mexican region : Mesquit, yucca, guaiacum. Northern Pacific region : Spruce, hemlock, canoe birch, balsam, poplar, and aspen. Pacific coast, between the ocean and eastern slopes of the Cascades : Cedar, spruce, hemlock, red fir, in the north ; sequoia, sugar pine, bull pine, in the south. Interior Pacific region, showing poverty of composition and development : Pines, juniper, aspen.

In general, it can be said that the Northern, Western, and Southern forests are largely coniferous ; while the Central States, especially of the interior, show hardly any coniferous growth.

The most interesting portion of the Atlantic region may be found in North Carolina, where Northern and Southern species occur on common ground, and the associated species naturally reach the highest number—not less than 120.

While the above remarks refer to the distribution of forest types over the continent, it must not be inferred that forest growth occurs everywhere, and exhibits the same or similar kinds in each region to which the above types refer. On the contrary, each region again exhibits a diversity of types which it would lead too far to analyze here. There are, however, large areas which are but scantily provided with forest growth, and other large areas which bear no forest at all. This distribution of forest, prairie, and treeless region, is exhibited in map No. 2. (Same source as map No. 1.)

Climatic conditions, due to geographic situation and influenced by peculiar configuration of soil and perhaps in some parts by human and animal agency, render a large area of the Western United States deficient in rainfall and humidity. In consequence, the interior east of the Sierra Nevadas, with the exception of the high Rocky Mountain range, is more or less treeless, the river bottoms alone being fringed with a few deciduous species.

To the east of this semi-arid region, which depends largely on irrigation for plant growth, at least at present, lies a belt of prairie region in which tree growth is easily kept back by the interference of man, cattle, or fire, but in the absence of this interference the forest grows without difficulty. The annual fires, which have probably destroyed the original forest and the young growth, being ever afterwards discontinued an increase of natural forest growth has been observable.

Coming to a closer examination of the species which compose the forests of the different regions, we will be interested in the general distribution of the more important genera and species. To this end, besides the table inserted further on, the maps which accompanied the census work of 1880, prepared under the direction of Prof. C. S. Sargent, furnish an admirable aid (Nos. 3 to 15), showing by different grades of color the number of species of the same genus which are found in the same field. A few of these maps show the distribution of one species alone. It is of course understood that the limits are the observed limits of botanical distribution, the region in which the species at present is known to occur naturally. With further exploration these fields may occasionally change, and have changed in some instances since the maps were made, but they give a good general idea of the capacity of the species with regard to climatic range.

Glancing rapidly over the maps we find, for instance, that the genus *Fraxinus* is most abundantly represented around the Great Lakes and the Upper Mississippi Basin; that one of them extends into the semi-arid regions, along the river courses to be sure, yet showing that with sufficient soil moisture the humidity of the atmosphere does not form an essential factor in its development.

It should be understood in looking over these maps that it is not necessarily the same species which are represented in different parts of the field bearing the same number; for instance, the western field "I" refers to *Fraxinus viridis*, while the northern field "I" represents the limits of *Fraxinus americana*, in each case one species of the genus occupying the field alone. These two species overlap each other along the 90th parallel, where the field is marked "II."

The genus *Carya* (hickory) on map No. 5, with 8 species, shows the greatest number of representatives in and around Arkansas.

On map No. 6 are shown the 3 species of *Juglans* (walnut), one of which is a western species, meeting the eastern *Juglans nigra* on a small territory in western Texas.

The genus *Quercus* (oak) has a very large number of representatives, 35 well-recognized species, the larger number of which occupy very largely the same area of distribution.

Map No. 7 shows very well how the fields of the 2 species of *Castanea* (chest-

nut), the one a Northern the other a more Southern species, overlap each other, the two occurring together only in the Alleghany region.

More than one-half the species of pine known to the world are indigenous to the United States. Their distribution on map No. 8 shows that in regard to numbers represented in any one locality southern California is richest, but the extent of the fields of distribution of each kind is very confined.

The largest field is occupied by the Northern gray pine (*Pinus banksiana*), which crosses the continent from the Atlantic to Alaska, where it meets *Pinus murrayana* and *tuberculata*.

The economically most important Northern pine of largest distribution is *Pinus Strobus* (white pine), associated in most of its territory with *Pinus resinosa*, but dividing it with *Pinus banksiana* in the North and with *Pinus rigida* in the East.

Of Southern pines *Pinus mitis* occupies the largest field, sharing it to a large extent with *Pinus tœda* and overlapping into the field of *Pinus palustris*.

The genus *Abies* and the genus *Picea* are exhibited in map No. 9. The widest range is occupied by the two spruces, *Picea alba* and *nigra*, together with *Abies balsamea*, which extend through the entire Northern forest, *Picea alba* reaching to the Pacific coast. The largest number of the *Abies* species belong to the Pacific region, with two (possibly three) species of *Picea*.

Maps 10, 11, and 12 show the distribution of several single species. Of the genus *Chamœcyparis* and *Cupressus* there are no conjoined fields, each of the seven species of these two genera occupying separate localities, excepting *Cupressus macnabiana* and *macrocarpa*, which, being quite rare and local, are found within the range of *Cupressus goveniana*. Maps 14 and 15 also represent species with separate fields of distribution.

Having thus passed in rapid review over the field of the forest flora, we are prepared to consider more in detail those species which demand special attention from the forester on account of their economic value.

It is not an easy matter to decide where to place the limit, nor can the lines be fixed with precision, and unchangeably. There are several considerations which will determine a species as forestally important: first, its quality and capacity for use in the arts; secondly, its quantity or occurrence in a natural state over large areas; thirdly, its occurrence in regions otherwise destitute of timber; fourthly, its capacity for forest growth in unfavorable localities or other qualities which make it desirable for forest-growing. The species which combine the first two requisites, namely, desirable quality of timber combined with large amounts obtainable, may be called preëminently valuable. These are, naturally, the present staples of our lumber market, and a brief account of them will appear later in this report in connection with the discussion on forest products.

There are other species which, although of inferior value, become important by covering large areas; as, for instance, the Lodge-pole pine (*Pinus murrayana*) and other pines of the northern Rocky Mountain region, and the white spruce (*Picea alba*) of the northern Atlantic region. Some species of excellent quality are confined to small areas of distribution, while capable of having their field extended artificially; such are *Catalpa*, *Torreya*, etc.

Others, like the mesquite in the southwestern part of the arid regions, is the only staple on hand in quantities, and therefore highly important, especially as it is capable of withstanding unfavorable climate and damage by fire and cattle.

Others again, like *Negundo aceroides* and *Fraxinus viridis*, although of poor quality, are useful in the reforestation of the treeless plains; and the cottonwood, which is among the poorest timbers, yet has been of incalculable value to the settlers in the Western treeless region, being easy of propagation and of rapid growth, even under most unfavorable conditions.

And after all, with the rapid denudation of our natural forests, these species of inferior quality of wood but superior facilities for propagation and rapidity of

growth, will come more and more into use with the application of artificial methods and special processes for improving their quality, making them better fitted for use. So, for instance, the consumption of cottonwood for pulp and minor manufactures has grown to such an extent as to make this poorest of timbers a market staple in certain regions.

Although not more than 35 or 40 kinds of lumber are quoted in the market, some of them comprise the wood of several allied species, and although there are not less than 160 species used locally in manufactures, the forester will make a different selection of kinds as requiring his attention, keeping in mind the considerations before stated.

Exhibit II.—The exhibit of wood sections and botanical specimens represents such a selection of important timbers as have appeared to the writer to be of special forestal value. The number (125) could probably have been enlarged without overstepping proper bounds, and there may be a difference of opinion as to the propriety of this or that species in the collection. Limitation of space has necessitated in a few cases, presenting the wood section of one species and the botanical specimen of another allied species, or else only one or a few representative species of a genus, without intending to exclude the other species from consideration; for instance, of the seven species of magnolia only three are exhibited, while one or two others may claim attention in the same degree; of the two species of Tilia only one is represented, while the other may economically show no difference. There is also no reason why *Quercus coccinea* should be left out when the closely allied *Quercus tinctoria* is exhibited.

In the subjoined table those genera have been noted which contain species the wood of which is used in the arts. That is to say, in the 65 genera enumerated with 276 species, there are 163 species, or nearly two-fifths of the entire forest flora of 412 species, which are noted as of commercial value or find application in the arts. Of this number, 45 furnish more or less valuable marketable lumber and may be classed as lumber woods. In addition, 45 others are useful as furnishing piles, telegraph poles, railway ties, posts, and other fencing material; 36 are used in the manufacture of furniture, cabinet ware, and the like; 48 are in demand for turnery goods, wooden ware, and other light articles, and 34 are used for carriage-building, house-finishing, and similar work. Out of this number the 125 species on exhibition have been selected. The numbers in the last column refer to the serial number given in Prof. C. S. Sargent's catalogue, and to obviate any confusion in nomenclature and facilitate the study of the species, the same number has been attached to every specimen of the same species appearing in the exhibit, whether of wood, or botanical specimen, or photograph.

Family.	Genus.	Total number.	Atlantic region.	Pacific region.	Common to both regions.	Used in arts or of frequent occurrence.	Exhibited in collection.	Current numbers exhibited.
Magnoliaceæ	Magnolia	7	7	......	......	3	3	1, 2, 3.
	Liriodendron	1	1	......	......	1	1	8.
Ternstrœmiaceæ	Gordonia	2	2	......	......	1	......	
Tiliaceæ	Tilia	2	2	......	......	2	1	17.
Zygophyllaceæ	Guaiacum	1	1	......	......	1	......	
Meliaceæ	Swietenia	1	1	......	......	1	......	
Ilicineæ	Ilex	4	4	......	......	1	1	33.
Sapindaceæ	Æsculus	3	2	1	......	1	2	50, 51.
	Sapindus	2	2	......	......	1	......	
	Hypelate	2	2	......	......	2	......	
	Acer	9	5	4	......	5	4	60, 64–66.
	Negundo	2	1	1	......	2	1	67.

Family.	Genus.	Total number.	Atlantic region.	Pacific region.	Common to both regions.	Used in arts or of frequent occurrence.	Exhibited in collection.	Current numbers exhibited.
Anacardiaceæ	Rhus	5	5	.....	.....	2	.....	
Leguminosæ	Robinia	3	2	1	.....	1	1	77.
	Cladrastis	1	1	.....	.....	1	.....	
	Gymnocladus	1	1	.....	.....	1	1	85.
	Gleditschia	2	2	.....	.....	2	1	86.
	Prosopis	2	.....	2	.....	2	1	93.
Rosaceæ	Prunus	11	7	4	.....	2	1	108.
	Pyrus	5	3	2	.....	3	.....	
Hamamelaceæ	Liquidambar	1	1	.....	.....	1	1	139.
Cornaceæ	Cornus	3	2	1	.....	2	.....	
	Nyssa	3	3	.....	.....	2	2	154, 155.
Ericaceæ	Arbutus	3	.....	3	.....	1	.....	
	Oxydendrum	1	1	.....	.....	1	.....	
	Kalmia	1	1	.....	.....	1	.....	
	Rhododendron	1	1	.....	.....	1	.....	
Sapotaceæ	Bumelia	5	4	1	.....	1	.....	
Ebenaceæ	Diospyros	2	2	.....	.....	2	1	184.
Oleaceæ	Fraxinus	10	6	4	.....	6	6	192-194, 196-198.
Bignoniaceæ	Catalpa	2	2	.....	.....	2	2	206, 207.
Lauraceæ	Sassafras	1	1	.....	.....	1	1	217.
	Umbellularia	1	.....	1	.....	1	.....	
Urticaceæ	Ulmus	5	5	.....	.....	5	4	223-226.
	Celtis	1	1	.....	.....	1	1	228.
	Morus	2	1	1	.....	1	1	232.
	Maclura	1	1	.....	.....	1	1	234.
Platanaceæ	Platanus	3	1	2	.....	1	1	235.
Juglandaceæ	Juglans	3	2	1	.....	2	3	238-240.
	Carya	8	8	.....	.....	7	7	241-247.
Cupuliferæ	Quercus	37	23	14	.....	22	15	251, 252, 254, 256, 258-260, 267, 268, 272, 274, 276, 277, 279, 280.
	Castanopsis	1	.....	1	.....	1	1	288.
	Castanea	2	2	.....	.....	2	1	290.
	Fagus	1	1	.....	.....	1	1	291.
	Ostrya	1	1	.....	.....	1	1	292.
	Carpinus	1	1	.....	.....	1	1	293.
Betulaceæ	Betula	6	4	1	1	5	3	295, 297, 299.
	Alnus	6	3	3	.....	2	1	301.
Salicaceæ	Salix	12	2	7	3	2	1	306.
	Populus	8	2	3	3	4	5	318, 319, 321, 324, 325.
Coniferæ	Libocedrus	1	.....	1	.....	1	1	326.
	Thuya	2	1	1	.....	2	2	327, 328.
	Chamæcyparis	3	1	2	.....	3	2	329, 331.
	Cupressus	4	.....	4	.....	1	.....	
	Juniperus	4	.....	3	1	2	4	336-339.
	Taxodium	1	1	.....	.....	1	1	340.
	Sequoia	2	.....	2	.....	2	1	342.
	Taxus	2	1	1	.....	1	.....	
	Torreya	2	1	1	.....	1	1	345.
	Pinus	35	13	22	.....	20	22	347, 349, 350, 355-358, 361, 362, 364, 366, 368, 370, 371, 373, 375-381.
	Picea	5	1	3	1	4	4	382-384, 386.
	Tsuga	4	2	2	.....	2	2	387, 389.
	Pseudotsuga	1	.....	1	.....	1	1	391.
	Abies	9	2	7	.....	4	3	395, 396, 398.
	Larix	3	1	2	.....	2	2	401, 402.
	Total	276	157	110	9	163	125	

To further facilitate the study of these 125 species, they have been divided into groups of botanically allied species, and the wood sections, mounted on panels, are surrounded by the botanical specimens belonging to the group of woods on the panel. As a rule, the less important representatives of the group have been placed on a panel below the main panel.

The labels accompanying this collection of woods deserve special attention. They

contain not only the botanical name, with English, and where possible, French equivalent, but also a brief description of the tree, the qualities of its wood and its use, besides a map showing its field of distribution. The descriptions have been taken from Prof. C. S. Sargent's catalogue of the Jesup Collection, American Museum of Natural History, in New York. The idea of presenting the field of distribution graphically on a map must also be credited to the same source, only the combination of map and description being original. Thanks are due to Mr. Jesup for furnishing the base of these labels, and 97 of the fields copied from similar maps of his collection.

It will be of interest to add here a few words in regard to this remarkable collection of woods which owes its origin to the generosity of Mr. Morris K. Jesup and bears his name. It is certainly the most unique collection of the kind in the world, and will no doubt remain so, containing not only a complete representation of the United States forest flora, but the largest specimens that could be found of each species; many of the specimens are over 3 and 4 feet in diameter, being full round sections, and the height for the most part is uniformly 6 feet. While this monster collection gives a fair idea of the possibilities of development in the virgin forest, it will be necessary to supplement it by a collection of hand specimens for closer inspection, which I believe is contemplated.

The table produced before will aid somewhat in forming an idea of the United States forest flora as represented within the panels and cases of this exhibit.

A discussion of the various species exhibited in this place would extend this report beyond proper limits, and is made unnecessary by the special labels which give all desirable information.

To further elucidate the botanical characters of our forest flora, recourse is had in this collection to photographs and colored illustrations. It is with peculiar satisfaction that the writer calls attention to the exhibit of 240 colored plates, taken from the work of the North American Sylva, of André François Michaux,* who, together with his father, was among the first to publish an exhaustive account of our forest flora.

No botanists deserve more honorable notice in connection with American forestry than these two Frenchmen, who not only devoted a large part of their lives with rare zeal and energy to the exploration of our American forests, but translated their love for this study into practical action by leaving two legacies for the pur-

*_André Michaux_ (born in 1746) came to America in 1785, and during the nine years that he remained here traveled extensively in the Middle, Southern, and Western States, and northward toward Hudson Bay, procuring trees for the establishment at Rambouillet, France, to which he sent 60,000 stocks.

In 1801 he published in Paris a folio volume with 36 plates, entitled "Histoire des Chênes de l'Amérique, ou descriptions et figures de toutes les espèces et variétés d'Amérique Septentrionale, considérés sous les rapports de la botanique, de leur culture, et de leur usage."

In 1803 there was published in his name at Paris, in 2 volumes, 8vo, a work entitled "Flora Borealis Americana, sistens caracteres plantarum quas in America Septentrionali, collegit et dexterit," with 51 plates. The author had set out on an expedition to New Holland in 1800, and died in Madagascar in 1802, before this work was issued.

André François Michaux, son of the preceding, was born in 1770, and died in Paris October 23, 1855. Having resided and traveled in this country several years, he published in Paris in 1805 an octavo tract, entitled "Mémoire sur la naturalisation des arbres forestiers de l'Amérique Septentrionale," and the year previous a volume of travels in Ohio, Kentucky, and Tennessee, in French. The latter was translated into English and published in London in 1805.

In 1810 he published at Paris, in 3 volumes, a magnificent work entitled "Histoire des arbres forestiers de l'Amérique Septentrionale, considérés principalement sous les rapports de leur usages, dans les Arts et dans leur introduction dans le Commerce."

In the same year appeared the "Histoire des Pins et des Sapins de l'Amérique Septentrionale," 4to. In 1819 he published in Paris, in 3 volumes, the North American Sylva: "A Description of the Forest Trees of the United States, Canada, and Nova Scotia, with a Description of the most useful European Forest Trees," translated from the French by Augustus L. Hillhouse. This has since been published at New Harmony, Ind., and at Philadelphia, from the original engraved plates, and two volumes added, in 1859, by Thomas Nuttall.

pose of encouraging the study of sylviculture in the United States. The subjoined notes on the work of these two men will be of interest. The memorial inscription, which with a steel engraving of the elder Michaux and the title-page of the North American Sylva heads this exhibit, will explain further the existence of the same as a recognition of the generous action of the two Frenchmen. On this occasion the inscription, translated into English, read as follows:

"In memory of the two eminent French scientists, Michaux, father and son, who were the first to explore and describe the forest flora of North America and in recognition of their generous bequest for the encouragement and study of sylviculture in the United States of America, the Massachusetts Society for the Promotion of Agriculture, which is the trustee of the said bequest, has sent to the Universal Exposition of 1889 these illustrations of the forest flora of the United States, as it was described by these two French botanists."

In his will, dated September 4, 1855, A. F. Michaux made the following provision: "Wishing to recognize the services and good reception, and the cordial hospitality which my father and myself together and separately have received during our long, and often perilous, travels in all the extent of the United States, as a mark of my lively gratitude, and also to contribute in that country to the extension and progress of agriculture, and more especially of sylviculture in the United States, I give and bequeath to the American Philosophical Society of Philadelphia, of which I have the honor to be a member, the sum of $12,000 (at 5.40 the dollar, 64,800 francs). I give and bequeath to the Society of Agriculture and Arts, in the State of Massachusetts, of which I have the honor to be a member, the sum of $8,000 (at 5.40 the dollar, 43,200 francs), these two sums together making 180,000, francs or again $20,000. I give and bequeath the sole ownership to these two abovesaid societies, and the usufruct to my aforesaid wife for her life."

The American Philosophical Society at Philadelphia being the trustee of one of the Michaux legacies, has devoted part of its income from this fund to aid in the beautification of Fairmount Park, especially by the propagation of the various species of oaks; another part is devoted to popular lectures on subjects connected with forest botany and forestry.

The bequest to the Massachusetts Society for the Promotion of Agriculture is applied to aid the botanical garden at Harvard and the Arnold Arboretum, and to the publication of pamphlets on forest culture. This society does also great service by paying large premiums for successful forest plantations. The writer wishes especially to acknowledge the readiness with which this society acted on his suggestion to send the exhibit just mentioned.

The work of the two Michaux, as supplemented by Nuttall, stands to-day unique of its kind, although much new material and revision of our knowledge has made it imperfect in matter, and a new work of the same kind is desirable. This need will shortly be supplied by Prof. C. S. Sargent, whose work on the Tenth Census in his report of the forests of North America, published in 1884, is well known. The illustrations for this new work, from the hands of Mr. A. F. Faxon, are to be of the highest type, not colored as are Michaux's, but copperplates. Most of the drawings—some 500—are finished, and the work of engraving is progressing.

Exhibit IV.—To illustrate the characteristics of tree growth, a number of photographic views have been collected in Exhibit IV. Since these photographs were not taken with their special application to this exhibit in view, they may not always present the objects in their most characteristic form, yet they aid in forming a conception of the forest growth of the United States. Especially the fine photographs of California timbers, presented by Mr. J. W. Taber, of San Francisco, give a good conception of the enormous sizes to which the growth attains on the Pacific coast.

The giant trees (*Sequoia gigantea*) which are found in a few small groves (Cala-

veras, Mariposa, and Fresno groves) scattered over quite a confined locality in the interior of California on the western slope of the Sierra Nevadas, are probably the largest representatives of the vegetable world in existence. Trees over 366 feet in height, with a trunk 116 feet in circumference, have been described and are not unusual, 300 feet being the average height.

These trees are also found throughout a stretch of forest 40 miles south of these groves. The largest specimens in the groves which are visited by the tourists have names attached to them, such as "Father of the Forest," "Grizzly Giant," "Old Bachelor," as represented in the collection of photographs. Not much less in height, though usually less developed in diameter, are the redwoods (*Sequoia sempervirens*), which cover a considerable belt along the coast ranges of California from Oregon south to within 100 miles north of San Francisco, with a scattered and less gigantic growth extending south of that city. The average size of saw logs of this timber, which is the staple of the California lumber market, is 6 to 8 feet in diameter, and large tracts are estimated to cut 250,000 feet per acre (1,470 cubic meter timber wood per hectare). There are about 1,000,000 acres which bear this kind of timber, estimated to contain somewhat over 30,000,000,000 feet B. M. (70,000,000 cubic meter timber wood). Within this region there exists great diversity in the general description of the redwood growth upon the ground, indicating different habits of the tree and varying peculiarities of growth and development; there is also noticeable a disparity in the density of growth.

It will appear astonishing to a European that in the manufacture of these trees into timber, the ratio of product to raw material in the standing tree must be placed at about 29 per cent, or for each foot of manufactured lumber leaving the mill, 3½ feet of lumber in the tree is consumed; 25 per cent of the trunk is left unutilized in the top and stump, and about 10 per cent is lost by breakage and other causes before reaching the mill, leaving it to be assumed that 65 per cent comes before the saw, which in the manufacture into lumber wastes, according to tests made on several thousand logs, about 36 per cent, leaving, as above stated, 29 per cent of marketable product. Present indications are that the virgin supplies can not satisfy the drain longer than 70 or 80 years, probably not so long, as the demand increases.

The power of reproduction, although the tree exhibits wonderful ability to resist destruction, is often overstated, the reproduction from seed being very scarce in the natural forest, while that from the stump which forms the rule, is not promising rapid reforestation. Yet the tree makes neither special demands as regards soil, nor as regards climatic conditions within certain limits.

The views from the Atlantic forests are bromide enlargements from negatives taken by Prof. J. T. Rothrock, of Philadelphia, from a collection of some 400 lantern slides made for use in the lectures for the Michaux fund referred to above; and by Mr. H. Brooks, of Boston, who proposes to publish a series of these photographs with texts.

Special attention is called to the shape of the Elm, which is particularly characteristic in its growth. The views of the Taxodium or Bald Cypress, especially the formation of the so-called cypress knees are of interest. And our European friends will view somewhat with disappointment what may be expected from a characteristic *Pinus rigida*, which by an egregious blunder has become an object of wholesale introduction into German experimental plantations of exotic forest species. It is quite certain that this introduction of a tree which at the best is of comparatively small value except for its capacity of thriving in the unfavorable conditions of the sand dunes, is due to a confusion of names. The common name of pitch pine, which belongs to not less than 5 or 6 species of different character and location, is applied to the valuable timber of the Long-leaf Pine in the London market, a pine which may be of value in southern France, but is beyond the range of a German

climate. The characteristics of this latter tree appear finely from two views; in the one appears the young plant, which in its first years of growth develops very much like an endogen in thickness but not in height (not over 5 inches), carrying a brush of long needles like a broom at its top; the growth in height and branching begins only with its seventh year. The other illustration gives a fair idea of some of the so-called long-leaf pine timber lands of northern Florida, an open growth with but few trees to the acre, offering no hindrance to horse or wagon.

The wasteful use of valuable material is illustrated on a felled black walnut tree, our most expensive furniture wood, of which the butt log has been taken, but the entire branch system and a high stump is left to rot or burn. This kind of illustration could have been multiplied *ad infinitum*, for the waste of good material, partly occasioned by the uneven development of the country, which makes the economical working of the forest often impossible, is nowhere greater than in the North American forests.

The illustrations furnished by Mr. Brooks give, by a wand placed across the trunk of the tree (5 feet), an idea of size.

Exhibit V.—Having become somewhat familiar with the outer appearance of the material which composes the living forest, we may study the structure and anatomy of the woods.

This can be done by the aid of transparent veneer sections, of which the Charles W. Spurr Veneer Company, of Boston, Massachusetts, has furnished a collection, exhibited in a swinging frame, and Mr. Romeyn B. Hough, of Lowville, New York, another collection in portfolio. A third, and quite novel, method of illustrating the anatomy of woods is presented in a series of photographs from microscopic sections, so-called photomicrographs, executed by Mr. Thomas. W. Smillie, of the National Museum, Washington, District of Columbia, for the permission of utilizing whose services the courtesy of the director of the Institution, Prof. G. Brown Goode, has placed the writer under obligations. A detailed discussion of this valuable exhibit is precluded in this report by limitations of space.

Exhibit VI.—Of specially interesting peculiarities which may be found in the North American forest, only a few samples are exhibited. Special attention deserves the curious excrescence of the roots of *Taxodium distichum*, called "cypress knees," which are found wherever this tree grows subject to inundation, in "cypress brakes." Latest researches affirm the function of this growth to be to assist in the aëration of the roots. Also a feature of Southern forests, especially of the live-oak groves in Florida and along the Gulf, is the "tree-beard moss," in reality not a moss, as commonly called, but a plant belonging to the family Bromeliaceæ, species *Tillandsia usneoides*, which, hanging in profusion from the branches of the trees, gives a strange, gaunt appearance to the scenery. Considerable quantities of this growth are gathered and manufactured into material for upholstery work. Two sections of wild grapevine show the enormous size to which this climber not infrequently attains, with a length of 150 to 200 feet.

Having thus become acquainted with the material which composes the forest, the methods of its production claim our attention.

FOREST CULTURE.

This section, necessarily, does not admit of much expansion in a country where, as stated before, forest management is almost unknown and forest planting has not yet become a practice and has not yet been developed into an organized industry or art. Excepting small groves planted in large numbers in the Western prairies and plains, the artificial plantations of forest for forest purposes are very few indeed, Massachusetts probably showing the greatest number, having in 1885 a reported number of artificial forests comprising 5,913 acres.

As to forest management, the nearest approach to anything like it could be found in the practice on the part of some lumbermen and owners of woodland who do not allow the cutting of trees of small diameter, expecting that these will grow to better value in a few years. The thought of perpetuation of the forest, and reproduction and the adoption of means to that end, hardly enters into the consideration of forest owners. Here and there a farmer will fence in a chestnut stump to protect the sprouts from being knawed by the cattle, or even an entire lot to save it from the same fate. Now and then inquiries are made as to the best methods of thinning out or other means of improving a "wild" wood lot of "second growth." But the cases where active steps are taken to apply the information are still probably very few.

In general, the method of utilizing the forest is that known under the name of "culling," which consists in cutting out the best and largest trees, or those of a certain kind, leaving the balance to take care of themselves. The consequences are different in different localities, according to the composition of the forest and other conditions.

In the deciduous woods the consequence is a change in the composition of the forest growth; so that, for instance in Kentucky, where the original growth was composed to the extent of 40 per cent of valuable white oak, the culled forest will not reproduce more than 5 per cent of this species, the remaining growth of inferior kinds having been given undue preponderance and power to keep down the better kinds. In the pineries and on the thinner soils of deciduous woods, fire is apt to run over the ground which the lumberman has left covered with branches, chips, and rejected timber, and which, opened up to the direct rays of the sun, is left so inflammable that a spark is sufficient to ignite it and the heat sufficient, if not to consume, yet to destroy much of the standing timber and the forest cover. When the fire has run its course the scarred and blackened trunks remain standing, while the seedling and the seed in the ground have been consumed. If any useful timber is left and other conditions would make it profitable to use up the remaining timber, this is sometimes removed. Deterioration of the soil is the inevitable consequence, and change of soil cover. The nature of the new cover varies according to locality. In some, especially mountainous localities, an absolute barren waste is the consequence, from which the thin soil, if it has not been burned off, is soon swept off by the rains; in other places brambles and weeds spread over the area; in others again a growth of inferior, often very objectionable, scrubby trees. In the Northeast it is the wild cherry, or worse, the scrub oak; in the Southern woods some of the inferior pines, *Pinus inops*, or, if luck will have it, the better old-field pine (*Pinus tæda*) may occupy the place; in the mountains the quaking aspen (*Populus tremuloides*) must be welcomed as a preserver of the soil and protector to future generations of better kinds, the seeds of which may find entrance, gradually recovering the place and crowding out the poplar. Much philosophy has been called into requisition to explain the peculiar alternations of forest growth in the United States subsequent to the interference of man by ax and fire. There are, however, no other causes for this change than are at work the world over, depending on four factors, which partly lie in fortuitous circumstances, partly in the nature of the tree species which alternate. These are: (1) The presence on the ground of a hardy species, which has maintained life for some time unnoticed in spite of adversities. This explains the springing up of oak in the prairie regions after the fires are discontinued, or the occupation of the ground by the oak after the overshadowing pines are removed. (2) The occurrence of a prolific seed year for one of the species composing the forest at the time of removal. Thus white pine may follow white pine, if cut during a seed year. (3) Frequent and prolific seed-bearing in one kind will give advantage over a species which bears more rarely and is less prolific, to which must be added facility in the distribution of the seed. Thus the prolific seeding of scrub pines and

of the old-field pine gives advantage over the longleaf and other pines. The ease with which the aspen wafts its seed in every direction accounts for its ubiquitous presence. (4) The capacity for rapid development under favorable conditions, especially vigorous germinative power and capacity to develop under the direct influence of the sun. Prolific seeders with light seeds show generally this capacity, hence the spread of poplars and birches. The coppice growth, which abounds in the Central and Eastern States, also changes in character by cutting in it during the whole year, by which practice the kinds with less vigorous sprouting capacity are gradually exterminated.

Altogether, it may be said that the forest management of the United States consists in wasteful and irrational utilization of the natural crop, while reproduction is governed almost entirely by accident.

Since no special place has been made for forest statistics, such as bear upon forest management in general have been included in this subsection.

Exhibit VII consists of a large wall-map (17 by 12 feet), showing the distribution of forest areas over the United States.

In regard to forest statistics in the United States it must be premised that, owing to the large areas of sparsely settled country, the lack of competent observers, and the absence of special interest with many, such statistics are among the most difficult to obtain. At present, approximations only can be made. Yet the approximations, as expressed on the map referred to, may well be taken as coming near the truth since they move in wide limits.

For each State the proportion of woodland to the total area of the State has been expressed in percentages, and by coloring the States with a different shade of color—each shade representing a range of 15 per cent—a ready comparison of general forest conditions is presented. Those States and Territories which have less than 15 per cent of their area covered by forest growth are left uncolored, while those showing more than 60 per cent, bearing the darkest shade, are not further classified.

In addition to this relation of forest area to total area, that locality in each State where the largest per cent of forest growth occurs has been denoted by means of a stamp in tree form. It will be borne in mind that there is no relation or comparison to be found between the localities thus marked, but they refer exclusively to each State; thus we find, for instance, that of the 15 to 30 per cent of forest growth which are credited to Kansas, the largest amount is found on the eastern boundary, while in fact the western part has no forest at all; the entire forest growth of Colorado is confined to the mountain region; Alabama, which is a densely forested State in all parts, shows two areas of comparatively denser forest growth, or rather such as have been less opened up and cleared.

The total forest area of the United States, exclusive of Alaska, may be estimated in round figures as 500,000,000 acres, or about 27 per cent of the total land area. Of this forest area 38 per cent is in the hands of farmers or incorporated with the farms, which part gives a greater promise for its future than the so-called "wild" lands, which are held by lumbermen, speculators, and nonresident owners. In regard to territorial distribution the map gives ready answer. The New England States, although among the oldest settled, show over 47 per cent of their area covered by wood growth, the heavily wooded Maine (63 per cent) still containing much virgin timber, the other States mostly in coppice growth and so-called "second growth," which is the growth consequent to the removal of the virgin timber. The Middle Atlantic States, New York to Maryland, have less than 28 per cent of forest area. The Southern States, if grouped together, show over 50 per cent forested, the Northern lumbering States (Michigan, Wisconsin, and Minnesota) falling but little below that percentage (49.9). The Northern agricultural States, Ohio, Indiana, and Illinois, if grouped together, show less than 15 per cent wooded, most or all

their forest area being included in farms. The prairie States do not reach 5 per cent of wooded area, while the eastern Rocky Mountain region, with over half its territory treeless, is made by its mountain forests to exhibit 17 per cent covered, and the territory west of the mountains have hardly 10 per cent in forest. Texas, treeless over most of its immense territory, is quite densely timbered in the eastern part of the State over a small area, which gives to the whole State a percentage of 23, and the Pacific coast has about one-third of its area in timber, southern California being almost or entirely treeless.

To be sure, the forest areas are constantly changing by the opening of new farms and by abandonment of old fields to natural reforestation. There would also be differences expected in the figures, according to what is classed as woodland, often including probably waste brush lands without a prospective forest value in the near future.

With the absence of a systematic forest culture it is natural that its accessories should only be partially and imperfectly developed. The first of these accessories is the seed supply in the market. As far as known to the writer, there are only two firms in the United States who endeavor to collect a more or less full list of tree seeds. These are J. A. Thorburn, of New York, and Thos. Meehan & Sons, of Germantown, Pennsylvania. Other firms in various localities collect specialties according to their local facilities, and the nurserymen, besides collecting for their own use, make it a practice to keep some supplies of seed on hand for their customers. The difficulties besetting the tree-seed dealer are manifold, the greatest being the uncertain demand and the long list of desirable tree species, the perishableness of the stock (at least of many kinds), the scarcity of reliable collectors, and the expense of collecting.

Curiously enough, with regard to tree seeds, the rule that the larger quantity insures a lower price does not always hold good, since a small quantity may be within easy reach of the collector while larger amounts are difficult to bring together. Under such difficulties it is no wonder that until recently the supply of white pine seed used to be imported from Germany. The seeds of black locust could be brought much more cheaply from France; and altogether, the demand of having seeds from certain definite localities within the range of the species, which is of importance, can not often be enforced.

In Exhibit VIII are represented 100 species of forest-tree seeds. Just as the necessity of getting acquainted with the life history of our long list of important timber trees, so the need of diagnosing the seeds of such an array will stagger the European forester, who has to deal with hardly more than 20 or 30 species.

There are in this collection by no means all the kinds that should be represented; for a collection which is to serve as a check to discover substitutes should contain, if not all, yet the seeds of those kinds which by their frequency of occurrence may lead to confusion or substitution. Yet the collection contains the most important ones. It is not easy by mere description to give a diagnosis of the seed. and often the discrimination is almost impossible without the entire fruit; for instance, the outer shell, husk, or cup is desirable for the distinction of the cupuliferæ and juglandaceæ, and for the distinction of the pines the cone would be almost indispensable.

An attempt to diagnose the seed of a few genera of more importance will disclose these difficulties.

Taking the genus Carya, we find 7 species needing attention. The oblong, narrow, and smooth nut of *Carya olivæformis* at once distinguishes it from the rest; the flat, deeply wrinkled, dark-colored nut of *Carya aquatica* excludes it from further comparison. *Carya porcina* and *amara* are both smooth and spherical in shape, but *amara* can be readily distinguished by its thin shell and bitter, astringent taste. A squarish appearance, due to four pronounced elevated ridges, characterizes *Carya tomentosa, alba,* and *sulcata; Carya tomentosa* may, by a practiced eye, be distin-

guished from the other two by its more spheroidal shape, while *alba* and *sulcata* appear more pear-shaped, These latter two are very difficult to separate, except that in general *sulcata* has a bigger nut, and possibly a characteristic reddish veining which appears on *Carya alba* may be constant. With these the better plan would be to have some shucks with the seed, when it would appear that *sulcata* has a considerably larger and thicker shuck than *alba*, the former being at least 2 inches, the latter not likely over $1\frac{1}{2}$ inches in diameter.

The Maples may be distinguished by the manner in which the wing is inclosing the seed and its outlines and by the shape of the angle which the pair of seed make with each other, called sinus. *Acer macrophyllum* from the Pacific coast, is unmistakable by its size and hairiness; *Acer saccharinum*, by its short, round, and thick seed and broad, squarish sinus. If the larger wing did not distinguish *Acer dasycarpum* from *Acer rubrum*, the very acute sinus as against an obtuse sinus of *rubrum* would do so. *Negundo aceroides* is peculiar by its rather elongated seed and by the arc in which the midvein of the wing ends, the point turning inward.

DIAGNOSIS OF THE SEED OF 10 PINES.

(*a*) *Large-sized seeds* ($\frac{1}{2}$ an inch long).

Pinus coulteri.—Flattened, but with no sharp edge; recognized by its glossy black color on one side and a dull gray-black on the other.

Pinus lambertiana.—Much flattened and with a rather sharp edge all around; easily known by one side being dark satiny brown and the other side lighter and often with pink specks.

Pinus edulis.—Oblong and plump, very smooth; known by its rich umber brown and dull ocher-yellow specks and areas.

(*b*) *Middle-sized seeds* ($\frac{2}{5}$ to nearly $\frac{1}{2}$ an inch long).

Pinus ponderosa (nearly $\frac{1}{2}$ an inch long). Dark chocolate satiny brown on one side, and dull yellowish with confluent specks of brown on the other.

Pinus palustris ($\frac{2}{5}$ of an inch long). Grayish on one side and only slightly brownish on the other, the lighter side strongly marked with oblique furrows.

(*c*) *Moderately small seeds* ($\frac{3}{10}$ of an inch long).

Pinus insignis.—Blackish, and easily recognized by its rough tubercular surface.

Pinus strobus.—Smooth, satiny brown on one side; light grayish on the other, with a mottling of dark-brown specks.

(*d*) *Very small seeds* ($\frac{3}{20}$ of an inch long).

Pinus rigida.—Flattened and sharp edged; easily recognized by the dull lead-black color; only occasionally mottled with white specks.

Pinus resinosa.—Generally recognized by its plumpness, dull clay-yellow color and absence of distinct markings. (*Pinus banksiana* very similar, but distinguished by having sharply defined markings).

Pinus mitis.—(Flattened and with sharp edge on one side). Sharply mottled with dark-brown, and yellowish areas.

DIAGNOSIS OF ACORNS.

WHITE OAKS (meat white in fresh seed):

Acorns entirely inclosed in cups, or nearly so .... *Quercus lyrata.*

Acorns dropping out of cups:

Large-sized acorns:

Cylindrical, much flattened at both ends, top end grayish, velvety .... *Quercus macrocarpa.*

Tapering from the base, no grayish velvet marking...... *Quercus michauxii.*

Conical and much enlongated (live oak)................... *Quercus lobata.*

Middle-sized:
- Smooth or glossy surface:
  - Glossy, tapering at both ends; base thickened, bulging.... *Quercus prinus.*
  - Not glossy, tapering more toward the top end; base thin, flat. *Quercus alba.*
- Downy surface:
  - Minutely downy; brown color, base broad, more or less obtuse at top.... *Quercus bicolor.*
  - Densely downy or velvety; yellowish color; base very small; acute at top.... *Quercus densiflora.*

Small-sized:
- Egg-shaped (two species very similar in form and difficult to distinguish without the cups):
  - Tapering toward the top end; cup shallow and sharp-edged.... *Quercus prinoides.*
  - Elliptical (somewhat uniformly); cup deep, thick edged. *Quercus obtusiloba.*
- Conical (live oaks):
  - Very sharply conical and elongated; mostly of one color.... *Quercus chrysolepis.*
  - Less pointed in form; upper half blackish brown.... *Quercus virens.*

BLACK OAKS (meat orange or yellowish color in fresh seed; great variation in form of fruit).

Large-sized:
- Flattened or concave base; dark reddish color (largest and broadest fruit of black oaks).... *Quercus rubra.*
- Roundish base:
  - Bulky and cylindrical in form.... *Quercus coccinea.*
  - Smaller and more conical, tapering from the base.... *Quercus tinctoria.*

Small-sized:
- Longer than broad:
  - Covered with thick tawny down, which is more or less persistent.... *Quercus nigra.*
- Broader than long:
  - Olive-colored:
    - Somewhat flattened, strongly marked with vertical stripes.... *Quercus palustris.*
    - Spherical, but resembling the former; only indistinctly striped.... *Quercus phellos.*
    - Spherical and minutely wrinkled.... *Quercus falcata.*
  - Dark chocolate color; sometimes slightly striped.... *Quercus aquatica.*

While there is not much systematic forest-planting done in the United States, yet American ingenuity has already successfully accomplished one thing which the older tree-planting nations have not attempted: the application of mechanics to plant-setting.

Exhibit IX shows the model of a tree-planting machine, just patented in the United States and foreign countries, the construction and application of which will be readily understood. It has been successfully used for two years in the plains of western Nebraska and promises to revolutionize forest-planting wherever the application of a plow is not excluded by conditions of the soil.

A coulter-plow cuts the sod and plows the ground 6 to 8 inches deep, a subsoil plow with broad nose opens a furrow 12 to 18 inches deep and by means of elongated land sides keeps it open for the setting of the plants. The plant-setting wheel is the novel part of the machine. It is propelled by walking sticks, which rotate the wheel by walking over the ground as the machine is moved. At equal

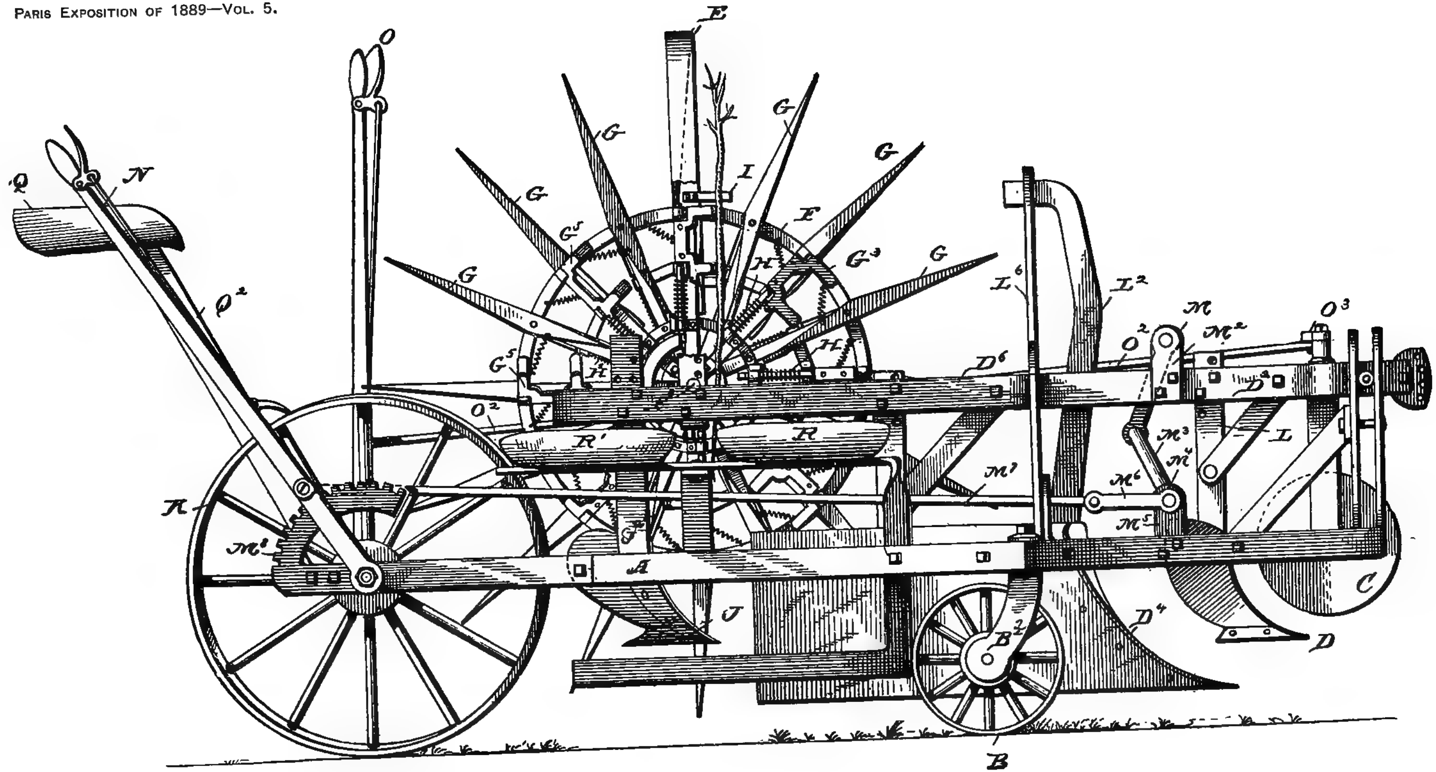
distances on both sides along the rim are fastened clamps of varying construction. The clamp on the model is so constructed that it will open and close automatically at given points, namely, at the highest point of the rotation, to take up the plant from a holder, into which it is fed by a man sitting at the side of the wheel, and again at the lower side to drop the plant. At this moment two shovels, following, fill in the earth around the plant, and the hind wheels with broad (6-inch) faces, set somewhat obliquely, press the root and soil together as no pressure of a man's foot can. (See Plates LXIII, LXIV and LXV.)

The full capacity of the machine has never been tested, but with the roughly constructed first machine 100,000 seedlings two to three years old were set in eight days by two men, and the latest performance has been 15,272 ash seedlings in nine hours, one man driving and one man feeding. The motive power of course depends on the nature the ground; not much more power is necessary than is required for plowing the soil. In the prairies this is best done by five horses. With sufficient power and help, the machine is expected to plant in the raw ground 30,000 plants per day. For planting conifers and other plants, such as tobacco, cabbage, etc., slight changes in construction are provided. This machine is not yet, but soon will be, placed on the market, and being of very simple construction will be salable at moderate prices.

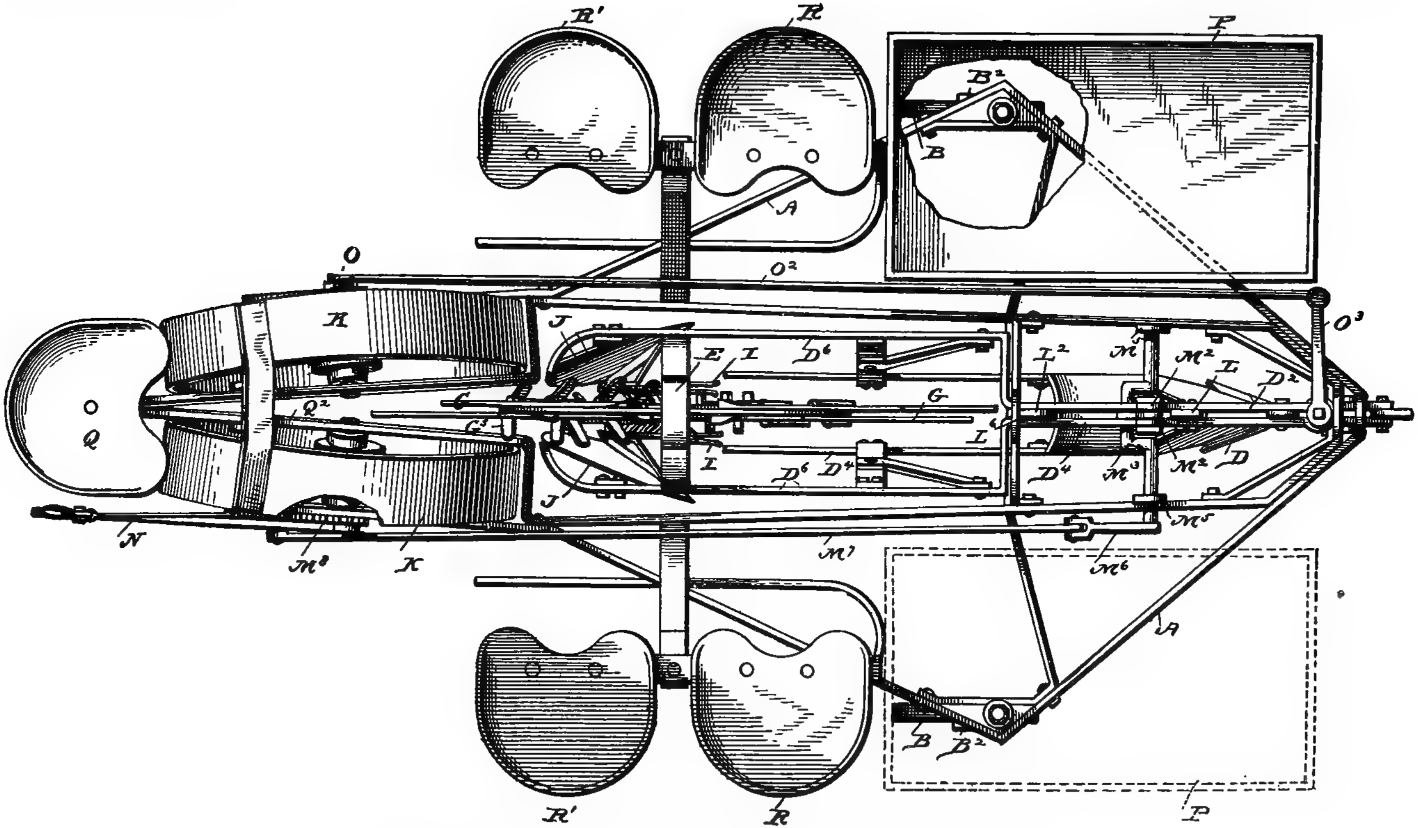
There has been, so far, little planting done in the United States, except on ground which can be cultivated with the plow, especially on the treeless plains and prairies. The general practice is to break the prairie sod in June, say 3 inches deep, and backset it deeper in August. The planting is then done at once or the ground is left till spring, when it is harrowed and sown to some field crop. The planting of trees is done either in the fall, October, or spring, March to May, according to locality, by plowing furrows, dropping the trees, mostly deciduous nursery-grown seedlings, into the furrow at regular distances and closing the furrow with the plow, straightening the plants afterwards. The species used for prairie planting are confined to but a few, which will withstand the rigorous climate with a possible annual range of temperature of over 150° and a possible daily range of over 50°, and in which the mean relative humidity during the months of vegetation may sink below 40 and even below 30 per cent.

The species most used are: *Populus monilifera*—mostly used in the shape of cuttings and for twenty or thirty years growing rapidly and successfully—*Negundo aceroides* and *Acer dasycarpum*, *Catalpa speciosa*, *Fraxinus viridis* and *F. americana*, *Juglans nigra*, *Prunus serotina*, *Gleditschia triacanthos* in the Southwest, and *Robinia pseudacacia* in the more northern parts. Some elms, Russian mulberry, an indefinite species or variety, and Osage orange (*Maclura aurantiaca*) are also found quite frequently. With conifers but little experiment has been made. The ubiquitous *Juniperus virginiana* succeeds quite well in the southwestern parts, *Pinus sylvestris* and *P. austriaca* have had more trials in experimental grounds than some native species which would be more commendable, and the fame of *Larix europæa* has induced its planting in the most improper places. In Southern California various eucalypti and acacias have also been well introduced.

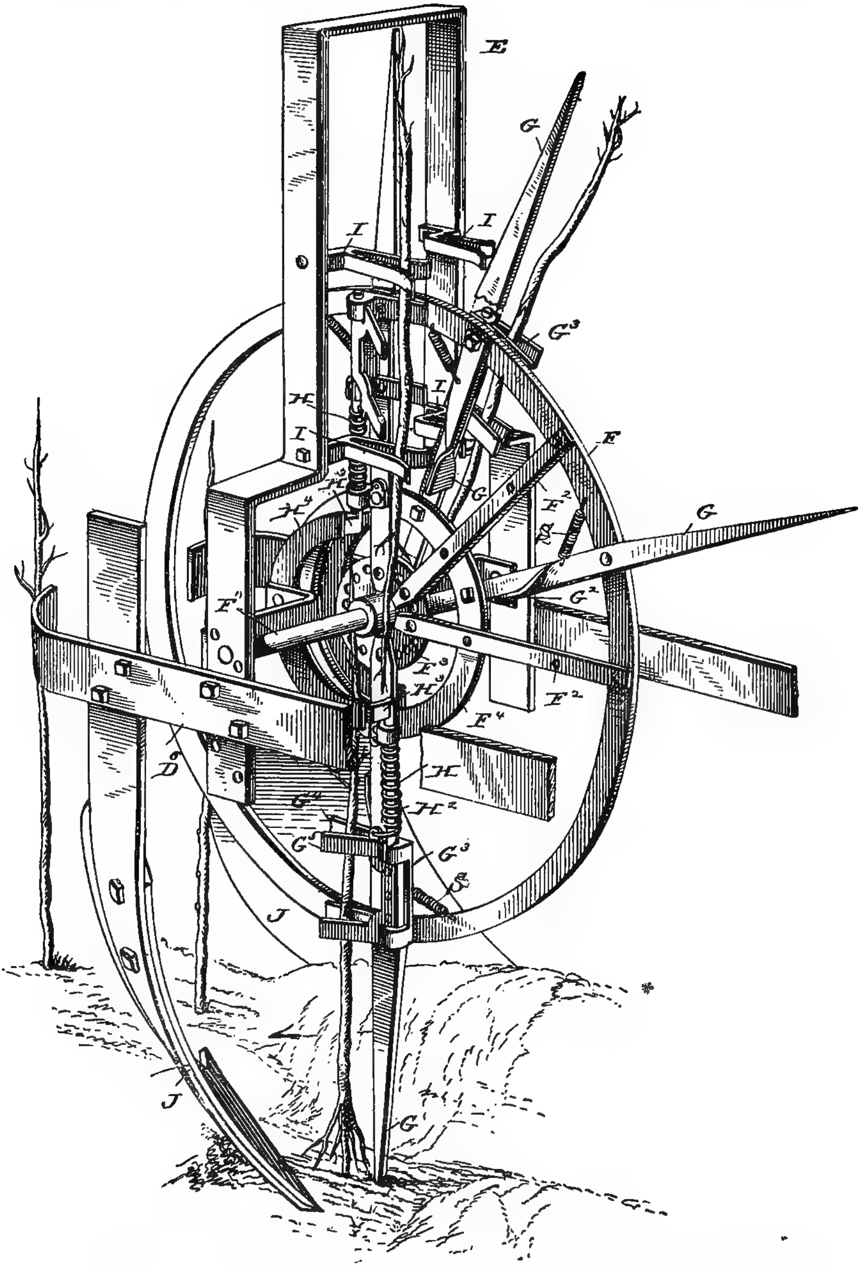
Exhibit X will be found novel in its make-up. It consists of 46 sets of cross-sections, 5 sections from each tree, taken at the base and every three feet (1m.) of each other, mounted together, so that each set represents a 12-foot pole with its varying diameters. The object of the exhibit is to give a conception of the rate of growth of the species represented. These are for the most part planted and come from various parts of the country, climatically different, namely, from the Atlantic Coast climate of Massachusetts, the specimens being furnished from the Arnold Arboretum near Boston, by Prof. C. S. Sargent; from the lake climate of Michigan, furnished from the plantation of the State Agricultural College, near Lansing, by Prof. J. W. Beal; from the prairie climate of Illinois, furnished from the planta-



TREE-PLANTING MACHINE (SIDE VIEW).



TREE-PLANTING MACHINE (VIEW FROM ABOVE, SHOWING BANKING-WHEELS).



TREE-PLANTING MACHINE (WALKING-WHEEL DETACHED, SHOWING GRAPPLER AND MANNER OF SETTING TREES).

tion of the State Agricultural College near Champaign, by Prof. T. W. Burrill; and lastly, from the prairie climate of eastern Kansas, furnished by Mr. George Nettleton, superintendent of the Fort Scott, Kansas City and Gulf Railroad, from their plantation at Farlington, one of the largest and best known plantations in that region. Special thanks are due these gentlemen for the readiness with which the sections were furnished, entailing considerable difficulties in their proper preparation. I should also mention that a similar collection from the University of Lincoln, Nebraska, prepared by Prof. C. E. Bessey, was unfortunately destroyed in a railroad wreck.

While so limited a collection can not of course allow much generalization, yet the student of tree growth will find much interesting and valuable material in this method of bringing the forest into the laboratory. Limited space forbids a more exhaustive analysis of the various specimens and a discussion of the comparative rates of growth of the different species in the different localities. The beholder will readily form an idea of the amount of information which may be derived from any one of the sets, in regard to rate of growth as well as to many characteristics and peculiarities in the development of the trees. One of these seems to be that as a rule the western aspect is the least favorable to development on the Atlantic side of the States, and it also appears that in the northern States it is the northwestern side subject to the influences of the cold winds; in the southwestern territory it is the southwest side, subject to hot blasts and sun-scald, which experiences retardation of growth, resulting in eccentricity of the axis towards that side.

As far as possible, the nature of the site on which the trees had grown is indicated on the label; also the age of the tree and the mean cross-section area which it had attained at that age, as calculated from the cross-sections up to a height of 12 feet. By dividing, therefore, this area, noted under the term mean accretion (*accroissement moyen*) by the age, we get the yearly average cross-section growth of the tree with reference to a 12-foot pole. It having been questioned of late whether in the prairie regions the "annual ring" is a true indicator of age, the collection from Kansas of trees of known age will be of interest as removing any such doubt, which has originated from statements of unpracticed observers. There are 26 species represented in the exhibit, several of which have representatives from each locality.

There are as yet not many attempts to be found in the United States of arboreta on a large scale. The only one which may compare itself with Kew Gardens in England or Barres-Vilmorin in France, at least in conception, is the Arnold Arboretum near Boston, under the direction of Prof. C. S. Sargent, a plan of which is exhibited together with the sections furnished from its grounds.

FOREST UTILIZATION.

We now come to consider the product of the forest as a staple of the market. While, as we have seen, the number of timbers applied or applicable to the arts exceeds 100, not all of these form regular articles of trade. The trade papers bring quotations of not more than 35 to 40 at the most, and of this number only about 10 or 12 are common staples of the lumber trade. Of these the white pine of the North (*Pinus strobus*) and the long-leaved and short-leaved pine of the South (*Pinus palustris* and *P. mitis*), which in trade are most frequently classed together as yellow pine or pitch pine, form the bulk. Lately a distinction is made between the two latter by denoting the long-leaved species as Georgia pine and the short-leaved as North Carolina pine.

The red or Norway pine of the North (*Pinus resinosa*), which used to be sold indiscriminately with white pine, is now often quoted separately, being a timber of special qualities differing from that of its companion.

Other coniferous lumber woods are the spruce, the black and white not being dis-

tinguished, the hemlock (*Tsuga canadensis*) and the white cedar (*Chamæcyparis sphæroidea*) in the North; the cypress (*Taxodium distichum*) and the red cedar or pencil cedar (*Juniperus virginiana*) in the South. The lumber woods of the Pacific slope are the redwood (*Sequoia sempervirens*) and the red fir, also called Oregon pine or Douglas spruce (*Pseudotsuga douglasii*), to which may be added the bull pine (*Pinus ponderosa*), the spruce (*Picea sitchensis*), also white fir (*Abies grandis*), and some cedar (*Chamæcyparis lawsoniana*).

The list of so-called "hard woods"—in which are classed all the deciduous woods—is larger and increasing in numbers, as new kinds are entering the market. The standard staples are whitewood or yellow poplar (*Liriodendron tulipifera*), which runs competition with the white pine for many uses; black walnut (*Juglans nigra*) and black cherry (*Prunus serotina*), which are our principal finishing woods; to which may be added red birch, sometimes called mountain mahogany, or black birch (*Betula lenta*) and yellow birch (*Betula lutea*), which are often not distinguished; red oak (*Quercus rubra*) or yellow oak (*Quercus tinctoria* or *coccinea*), which latter have of late become fashionable as furniture wood, quarter-sawed or bastard-sawed; and of late the sweet gum (*Liquidambar styraciflua*) has found its way into the market—at first under such fancy names as hazelwood, because of the earlier difficulties of keeping the wood from warping, but now sailing under its own colors. For wagon-building and finishing woods there are quoted white and black ash, hickory (without distinction of species), and maple, being distinguished into hard and soft maple (the first *Acer saccharinum*, the latter *Acer dasycarpum* and *rubrum*). White and burr oak, distinguished or not, are also common articles of market quotation. In addition to these may be found quoted basswood or linden, white birch, butternut, chestnut, cottonwood, sycamore, rock and soft elm, and beech.

These woods are sold either as lumber of varying width, thickness, and quality, by the thousand feet, board measure, or as timber of varying dimensions. All lumber boards are cut 12, 14, or 16 feet long, and 1, 1¼, or 2 inches thick. Each market has its own "inspection," *i. e.*, classification as to qualities. Taking the Chicago market—the largest market in the world, at least for white-pine supplies, handling all together not less than 200,000,000 cubic feet of wood (round 6,000,000 cubic meters)—we find the following menu of white pine alone, which will give an idea of the requirements of market inspection:

YARD QUOTATIONS, JOB LOTS, DRY.

Thick clears and selects, mixed lengths, dry, rough.

First and second clear, 2-inch	$47.00	C select, 1¼ and 1½-inch	$22.00
1¼ and 1½ inch	46.00	2-inch	24.00
Second clear, 1¼ and 1½ inch	41.00	2 by 4 clear and select, together.	28.00
2-inch	42.00	2 by 4 B select	22.00
A select, 1¼ and 1½ inch	36.00	2 by 6 clear and select	33.00
2-inch	39.00	2 by 8	36.00
B select, 1¼ and 1½ inch	32.00	All one length $1 extra.	
2-inch	33.00		

One-inch finishing, mixed lengths, rough.

First and second clear	$46.00	B, select	$28.00
Third clear	41.00	C, select	20.00
A select, 9-inch and upward	37.00	Thin clear and select, 9-inch up.	25.00
A and clear, 7 and 8 inch (base)	34.00	All one length $1 extra.	
B, 7 and 8 inch (base)	32.00		

Twelve-inch stock boards, rough.

A stock, 12, 14, and 16 feet	$41.00
B	37.00
C	33.00
D stock, 12, 14, and 16 feet	25.00
18 feet	27.00
20 feet	27.00
12-inch common, 12 feet	17.00
12-inch common, 14 and 16 feet	$15.50
18 feet	18.00
20 feet	19.00
10 feet	17.00
12-inch, No. 2, 12 feet	14.50
14 to 16 feet	13.50
10, 18, to 20 feet	15.00

Box boards, mixed length, rough.

A box, 13-inch and upward	$47.00
B	42.00
C box, 13-inch and upward	$35.00
D	27.00

All 14 feet $2 extra.

Add to foregoing prices for dressing one side, $1; two sides, $1.50.

Flooring strips, rough, 6-inch.

First and second clear, 16 feet	$40.00
A siding strips, 16 feet	37.00
A flooring strips, 16 feet	34.00
B	32.00
C	24.00
12 to 14 feet	$38.00
Do	36.00
Do	32.00
Do	31.00
Do	23.00

Timber, joist, and scantling.

	12 feet.	14 feet.	16 feet.	18 feet.	20 feet.	22 feet.	24 feet.
2 by 4	$13.00	$12.50	$12.50	$14.50	$14.50	$14.50	$15.00
2 by 6	12.50	12.50	12.50	13.50	14.00	15.50	16.00
2 by 8	12.50	12.50	12.50	13.50	14.50	14.00	14.50
2 by 10	12.50	12.50	12.50	13.00	13.50	15.00	14.50
2 by 12	14.00	14.00	14.00	14.00	15.00	15.50	15.50
3 by 12	14.00	14.00	14.00	14.50	15.00	15.50	15.50
3 by 14	14.50	14.50	14.50	15.00	16.00	17.00	18.00
3 by 16	16.00	16.00	16.00	18.00	20.00	21.00	21.00
4 by 4, 4 by 6	14.00	14.00	14.00	14.50	15.00	15.50	15.50
8 by 8, 8 by 10	14.00	14.00	14.00	14.50	15.00	15.00	15.00
Joist, 2 by 12, 3 by 12, 2 by 14, 26 feet long							$16.00 to 19.00
28 and 30 feet long							17.00 19.00
3 by 14, 26, 28, and 30 feet long							18.00 19.00
3 by 16, 26 and 28 feet long							22.00 23.00
3 by 16, 30 feet long							24.00
2-inch cull plank, promiscuous width							10.00
2 by 4 cull, 12, 14, and 16 feet							10.50

Heavy timber, 8 by 10 and larger, extra, according to size.

Flooring, dressed and matched.

A flooring, 6-inch	$34.00
B	33.00
C	25.00
No. 1 fencing, 6-inch d and m	17.00
10 ft	15.00
No. 2 fencing, 6-inch d and m, 12 and 14 ft	14.50
16 ft	15.00
No. 1 Norway fencing, 6-inch d and m	16.50
Clear and A, 4-inch, 12 and 14 ft.	32.00
16 ft	33.00
B flooring, 4-inch, 12 and 14 ft	30.00
16 ft	31.00
C flooring, 4-inch	$26.00
Norway clear and A, 4 or 6 inch.	24.00
Norway B, 6-inch	22.00
4-inch	22.00
C, 6-inch	18.50
C, 4-inch	18.50
8-inch No. 1 bds., d and m, or ship lap	16.00
10-inch No 1 bds., d and m, or ship lap	16.50
A partition, d and m 2 s, 4 bds.:	
B	35.00
C	27.00

Siding, tied.

First and second clear, 12, 14, and 16 ft $22.00
A siding 20.50
B siding $17.50
C 13.50
D 10.00

$\frac{7}{8}$-inch drop siding, 6 or 8 inch, 50 cents more than flooring.

Beaded ceiling, tied.

Clear $\frac{3}{8}$-inch, 4-inch $21.00
6-inch 22.50
A $\frac{3}{8}$-inch, 4-inch 20.00
6-inch 21.00
B $\frac{3}{8}$-inch, 4-inch 18.00
B $\frac{3}{8}$-inch, 6-inch $19.00
C $\frac{3}{8}$-inch, 4 and 6 inch 14.50
Clear and A $\frac{5}{8}$-inch 30.00
B $\frac{5}{8}$-inch, 6-inch 29.00

Common and cull boards.

Com. bds., 10, 18 ft $14.00
12 ft 14.50
14, 16, and 20 ft 14.00
No. 2 bds., all lengths 13.00
No. 3 bds., all lengths $10.50
Common, $1\frac{1}{4}$-inch 14.00
$1\frac{1}{2}$-inch 14.50

Common and cull fencing.

First qual. fcg, 16 ft $15.50
12, 14, 18, and 20 ft 15.00
Norway fencing, 12, 14, and 16 feet 15.00
No. 2 fencing, 16 ft 13.50
No. 2, 12, 14, 18, and 20 ft $13.00
No. 3 fencing, all lengths 10.00
Com. fcg, 4-inch, 12 and 14 ft 13.00
16 ft 14.00
4-inch No. 2, 12, 14, and 16 ft 12.00

Add to prices of boards and fencing for dressing one side, $1; two sides, $1.50.

Pickets and battens.

Pickets, flat, common $10.00
Fancy head and dressed, selected 18.00
$1\frac{1}{2}$-inch square, dressed and headed, selected 17.00
Battens, 2-inch, O G or bevel, per 100 lineal ft $0.45
$2\frac{1}{4}$-inch .... .55
$2\frac{1}{2}$-inch .... .60
3-inch .... .65

Shingles, carloads.

Extra A $2.60
Choice A 2.45
Standard A 2.35
Extra cedar *A* $2.45
Standard cedar 2.20
Clear pine 3.10

Five cents per M extra for end loading and less than carload lots.

Lath, carloads

Dry $2.20

To get at a comparative value of the different woods in the market, one may take the prices quoted for first quality lumber of the various kinds in New York. These, reduced to prices per cubic foot—to enable easier comparison with European prices—give the following scale. To obtain price per cubic meter in francs, multiply by 1.8.)

Coniferous woods.

Hemlock $0.16
Spruce .... .20
North Carolina pine .... .24

Red pine	$0.28
Red fir in California	.30
Yellow pine	.34
Cypress	.39
White cedar	.42
White pine and redwood	.60
Red cedar	.65

Deciduous (hard) woods.

Elm and cottonwood	$0.27 to $0.28
Beech, and soft maple, and sycamore	.30
Basswood and red birch	.38
Whitewood and black ash	.40
Red oak, hard maple, ch stnut	.42
White oak and sweet gum	.46
White ash	.48
Butternut	.60
Hickory	.70
Cherry	.96
Black walnut	1.40

These prices may be increased by 25 to 40 per cent for special qualities, and again reduced for common grades by 40 to 60 per cent, but they give a fair general idea in what esteem each of the different woods is held.

In the exhibit it has not been possible to do more than indicate by a few specimens the nature of our lumber product. In Exhibit XII an attempt has been made to give an idea of the sizes of our lumber. The Pacific coast furnishes perhaps the most gigantic growth of the world. Not only are the giant or mammoth trees and their more frequent congener, the redwood (*Sequoia gigantea* and *sempervirens*), enormous in their diameter and height development, but many other species, such as the red fir, bull pine, etc., furnish remarkably large-sized lumber. The redwood plank exhibited (about 2 meters in width) is indeed surpassed in the exhibit of the department by the top of the large table in the office of the representative; but it gives a fair idea of the size of the trees, the lumbering of which is represented in the series of photographs which accompany it.

On the Atlantic side of the continent the largest sizes are probably furnished by the tulip tree or yellow poplar, a slab of which is exhibited. Diameters of from 7 to 12 feet are found, and 4 to 6 feet, with a height of 100 to 150 feet, are not uncommon. The days of extraordinarily sized white-pine timber are gone; the large and clear sizes have become scarce; and although it is not impossible to replace many times the plank which the Paine Lumber Company, of Oshkosh, Wisconsin, has kindly furnished from its stock, yet a clear 2-inch plank 36 inches wide, like that exhibited, may be considered as a good average representative of the possibilities to which this species may attain.

The bald cypress of the South, which in quality somewhat resembles the redwood, is also noticeable on account of its large size and dense growths in the swamps, called cypress brakes; a fair-sized plank of this timber is exhibited. The difficulties which still attend the lumbering of this timber—a very interesting process itself—has somewhat retarded its introduction into the market.

There are also good-sized slabs of black walnut, black cherry, and birch exhibited.

Exhibit XIII shows some panels of a few varieties used as finishing or furniture woods, partly varnished; and in Exhibit XIV are shown curly and figured woods. There are several species which exhibit a peculiar wavy shape of the annual rings,

which when cut in a certain way give rise to the so-called bird's-eye, or curly, or blister, or figured grain in the lumber, resembling very much the grain usually found in burls.

By examining the sections of sugar maple in the portfolio (Exhibit No. 501), or in the frame (Exhibit No. 500), this peculiarity may be best studied, while the panel (No. 583) shows the unexcelled richness of the bird's-eye maple. The sugar maple (*Acer saccharinum*) is especially liable to this freak of nature, which remains as yet unexplained; it is also of quite frequent occurrence in the long-leaved pine of the South, of which a large panel with varying designs is exhibited. Another small slab of this wood shows a figured grain; another panel (No. 585) shows the same quality in the black walnut.

Exhibit XV.—To utilize these beautiful woods to their fullest extent, they are generally cut in veneers, which are used on a background of less rare and cheaper woods, in the same manner as the mahogany, rosewood, and other expensive exotic woods.

It has become fashionable of late to finish interiors of houses with wood. This has led to a novel method of backing veneers with paper, so that they can be used like wall paper, making the wood finishing for floors, ceilings, columns, balusters, tables, etc., considerably less in cost. The application of this method and other uses of veneers is shown in the exhibit of the Charles W. Spurr Company, of Boston, Massachusetts—two frames (Nos. 592 and 593)—while the tastefully arranged frame of Mr. Romeyn B. Hough, of Lowville, New York (No. 594), shows the use of veneer sections for business, visiting, and fancy cards, the wood in this case having been made pliable by special process.

There is perhaps no more interesting feature connected with forest utilization in the United States than the methods employed in bringing the timber from the stump into the market, called "lumbering" or "logging." This operation has been developed into an art of its own, and is carried on under a quite unique system. (See Plates LX, LXI, and LXII.)

In Exhibit XVI, I have been enabled to show by a series of photographs, representing lumbering scenes, the process by which in the various sections of the country the virgin forest is transferred into the lumber pile.

The views, arranged more or less in the sequence in which the operation progresses, need hardly any further explanation. The frame (No. 595) of 32 views from the California redwoods, for which thanks are due to Mr. I. E. Thayer, of San Francisco, California, is supplemented by larger views in portfolio (No. 596) furnished by the Humboldt Lumber Manufacturing Association, of Eureka, California, to be found in the office of the representative of this exhibition. The enormous size of logs to be handled in the redwoods has necessitated special machinery, and, one might imagine, a special race of men to run it.

In the Southern pineries (No. 597), where lumbering is carried on throughout the entire year, without reliance upon snow and ice and spring freshets, the methods differ somewhat from those exhibited in the scenes from the white-pine territory of the Northwest (No. 598).

Since this phase of forestry in the United States is perhaps the most characteristically American, the following brief description of the *modus operandi* as carried on in the pineries of Michigan, Wisconsin, and Maine may find appropriate place here.

The method of procedure in beginning a new winter's work in the Northwestern pineries would be about as follows: A "lumberman" is a man of some means, who makes it a business to contract to furnish logs for a sawmill, either from his own lands or from the lands of others from whom he has bought the "stumpage." The stumpage, *i. e.*, the right to cut the pine on a given area, is either paid for by the acre or by the 1,000 feet of logs. The stumpage of white pine now may

CHAMPION LOAD OF PINE LOGS (WESTERN MICHIGAN).

WHITE PINE LOGGING TRAIN (MICHIGAN).

WHITE PINE LOG-BANK READY FOR FLOATING (WESTERN MICHIGAN).

be set down as $4 to $6 per 1,000 feet B. M. (One foot, board measure, means the amount of wood contained in a piece 1 foot long, 1 foot wide, and 1 inch thick, equal to one-twelfth of a cubic foot.)

Having contracted to furnish 10,000,000 feet of timber to some mill, the lumberman will order one of his many foremen to hire a gang of men and build a set of camps on a certain river where he owns the stumpage, and prepare to lumber the required amount. To "put in" this amount of timber in what is called the "season," from September 1 to April 1, requires a camp of 100 men and 12 teams, if the length of the log road or "haul" does not exceed 2 miles. It is no small undertaking to pierce the unbroken forest for 40 to 50 miles from the nearest railroad, with the necessary supplies for such a camp. The "tote" road to camp having been cut out and "blazed," three "tote" teams must make daily journeys to the "front" to fetch the supplies for the men and beasts in the woods.

The site for the camp having been properly selected, four buildings are roughly put up, namely, a cook and eating camp; the bunk camp, with sleeping room for 100 men; the barn and stable, with room for 18 teams; with the store of hay and oats, and the blacksmith shop. In addition, a small van or office building is built for the "foreman" and "scaler," where also the tobacco, tools, etc., are kept. The "shanties" are built in a substantial manner with logs, and well "chinked" to keep the cold out, with the additional aid of a gigantic stove, and in a fortnight the camp is in condition to live in and to begin operations in the woods.

By 4 o'clock the camp is alive, by half past 4 the horn sounds for breakfast, which is prepared by the cooks with the aid of their chore boys, either on contract or from the company's supplies; by 5 the day's work begins, to be interrupted only by the dinner hour. The camp force is divided into sawyers, choppers, swampers, skidders, teamsters, and loaders. The choppers go ahead and cut a "nick" into a tree about 4 inches deep; the sawyers follow and from the opposite side saw the tree down; the swampers trim off the limbs after the sawyers have cut the trunk into log lengths; the skidders "snake" the logs to the skids, where they are piled up 20 feet high ready for the loaders and teamsters, when hauling begins, to be taken to the "banking" ground on the adjacent river, where the spring floods start them on their journey to the mill. With the coming of frost and snow the work of hauling begins. The log road is a wonderful piece of engineering. It goes around hills, over swamps, down and up ravines, a solid mass of snow and ice, made by the aid of the "sprinkler." The "sprinkler" is a tank holding 100 barrels of water placed on a sled, and through the long, bitter, frosty night it goes emptying its contents on the log road, until the latter is quite smooth. By this means loads of logs measuring over 23,000 feet, weighing 70 tons, as shown in one of the photographs (Pl. LX) may be drawn by one team of horses. As is shown in the series of photographs from the different sections, the method of lumbering differs somewhat, especially in the application of steam machinery, which is of more necessity in the forests of California, the logs being of too great size to be handled otherwise expeditiously.

When the "season" is over and the logs are "banked," another phase of logging or lumbering requires attention—getting the log supplies to the mill. Within a few years only—a decade perhaps—this is extensively done by railroads, but there is still much timber floated down the river, which used to be the only method in former times. The timber having been cut from the neighborhood of the rivers within easy reach, the rail and steam had to be substituted, at least for part of the way.

Among the various branches of lumbering, all more or less interspersed with danger, perhaps no one feature possesses more excitement, danger, and opportunities for the dare-devil disregard of death or accident which characterizes the woodman than the "river drive." Imagine a deep, narrow inland lumbering river, almost empty of water, but filled to the level of its banks with logs 30 to 40 tiers deep

and reaching up the stream about a mile in length, representing a mass of timber of, say, 75,000,000 feet, which have been "banked" during the winter. The rapid melting of the snow in the lumber woods will swell these streams to tumultuous rivers within ten hours, and frequently the "drive" is forced by the rapidly accumulating waters before the "river drivers" are ready. In front of the mass of logs fartherest down the river, the timber for 50 feet deep is piled in inextricable confusion in every conceivable form and shape, proving an impassive hindrance to the movement of the mass behind. This is the "breast" where the "breaking out" process must first begin. The increasing impulse of the water serves but to solidify the mass of timber together, impacting it more firmly upon the "jam" at its front, which must be removed before the logs can float down stream. The waters increasing, a miniature Niagara rolls over the "breast," making the work of starting the drive more difficult, arduous, and dangerous. But the work has to be done, and that quickly. If advantage be not taken of the flood water while at its height, the mass of logs may remain "hung up" for a whole year. The "driving crew," armed with pike, lever, and hook, and uniformed with knee boots heavily spiked on the soles and closely-fitting clothing, are now on the face of the "breast." Across the river over the breast is stretched a strong hawser. Atttached to this is a heavy block and tackle to which a large hook or skidding tongs is fastened, by which the jam logs are seized. Four or even six teams haul upon it till something gives way—rope, hook, chain sheave, or the log, which shoots down into the roaring water below? At the foot of the "breast," waist deep in the surging, chilly water, hemmed in by the dancing, rolling logs, are the bravest of the crew, wielding the ax to separate the "jam logs." On yonder log, setting out several feet of its length from the breast, see that man wielding the ax with skillful hand and rapid stroke to chop it in twain. The severing of that log is certain death, if he fails to jump when it succumbs to the last stroke. It bends and goes down while he lightly springs to another and is safe. Ten hours' work of this kind has exhausted men and beasts without result. The "breast" must be mined, but who is to do it? With logs rolling over the face of the breast in awful rapidity, there is but small chance for any man to return from such a task. There are, however, volunteers enough to place the dynamite cartridge, which breaks the jam with tremendous force, filling the air with logs, ice, splinters and smoke.

After the "drive" has been started the work of "bringing up the rear," or, in other words, getting the stranded logs afloat, is a work of no small proportions. Thousands of dollars' worth of timber is frequently left along the river shores, having drifted beyond the reach of the "rear men," and they remain "hung up," not reaching the "booming grounds" till another season's flood, or fall a prey to "timber pirates." Usually several firms start a drive together, each firm marking its own logs at the end with the marking hammer, the distribution to the several owners being done in the "boom."

Recently, by a series of dams, a greater control of the drive has been made possible, and the log crop is housed more safely. To further facilitate the business, great boom companies have been organized, who undertake the entire charge of rafting and sorting out the log crop, and delivering the logs in rafts to the various sawmills, which is done during the entire summer season.

In Exhibit XVII some of the utensils of a lumberman are exhibited. But for the lack of space this exhibit should have been fuller, for the improvement in tools as used by the American woodsman for making a tree into a lumber pile has reduced woodcraft to an art which is not known in European forests. The variously shaped axes, and especially their handles, and the American saw are perhaps well known and even introduced on the continent; but the pike levers, peavy hooks, skidding tongs, binding, skidding, and logging chain, trucks, sleds, drays, etc., have not been evolutionized to the degree of perfection there, as they are in our practice.

No. 599 shows the model of a sleigh, furnished by Alexander Hurtubise, of East Saginaw, Michigan, such as is used in drawing the monster loads alluded to before.

The substitution of metal roads and steam for ice roads and horseflesh, and of steam hoists and skidders for human muscle, has further improved methods, and an inspection of the model (No. 613) of a steam logging device, a machine which makes its own track or ice road while at work, which has only very recently begun its work in the woods, will show that forest utilization is still capable of improved methods, as far as simplification and rapidity of work is concerned. As regards fuller and more economical utilization of the product, we can discern that a beginning has been made toward improvement. The waste in the forest and out of it—very largely unnecessary—is still fearful to contemplate.

To get an idea of what the work of the lumberman in the Northwestern pineries means, I may state that one firm, and not the largest, put in, during the last season (1887–'88), 100,000,000 feet with a force of 450 men, 80 teams, 7 locomotives, and 32 miles of railroad.

The total amount of white pine timber cut for market during the last decade in the three States—Michigan, Wisconsin, and Minnesota—amounts to more than 60,000,000,000 feet B. M. (5,000,000,000 cubic feet), or during the last year, shingles included, nearly 9,000,000,000 feet. Of this kind of lumber Chicago alone handles about 25 per cent, and in addition over 300,000,000 feet of hard woods. The statistics of the cut of other woods are not to be had in any complete form, but by stating that the daily mill capacity of the United States may be figured at from 150,000,000 to 200,000,000 feet makes it reasonably certain that not less than 2,500-000,000 cubic feet of wood are converted annually into sawed products. To this should be added the following estimates of consumption—

	Cubic feet.
Railroad consumption	500, 000, 000
Mining timber	200, 000, 000
Charcoal	250, 000, 000
Fences	500, 000, 000
Sundry special purposes	150, 000, 000
Fuel	17, 500, 000, 000

to get at a rough idea of the total consumption of wood material in the United States, amounting to 22,000,000, 000 cubic feet.

Considering in addition the amount of material left in the woods in high stumps, tops, and branches, and the large amounts falling a prey to the yearly conflagrations, it appears quite reasonable to assume that our forest area of less than 500,000,000 acres is expected yearly to furnish 30,000,000,000 to 40,000,000,000 cubic feet, or 60 to 80 cubic feet per acre. Such an annual production is, to be sure, out of the question. How long the virgin timber and unaided natural reproduction will be able to furnish these supplies it is impossible even to guess ; yet the quick work which a modern sawmill is capable of making, with the ever-increasing demand for its product, will have persuaded every sane man that our forest resources are not inexhaustible, and that national forest management is the need of the hour of view, leaving out entirely the question of forest influences on water distribution even from a mercantile point and soil conditions or climate.

It remains to discuss two of the principal by-products, which are exhibited in two exhibits. The first (Exhibit XVIII) represents in a compact form the methods of obtaining the resinous products from the Southern pitch pines. Turpentine orcharding, as it is called, is an industry worthy of special mention as one of the most destructive agencies of the value of Southern pine lands, directly and indirectly. Its destructiveness is due simply to carelessness, improper methods, and lack of economic sense and organization. Large areas of timber are tapped and

worked to their utmost, and thus are soon exhausted of their resin supply. In many cases the timber is not at all utilized, and falls a prey to the conflagrations which are sure, sooner or later, to follow the turpentine orchardist.

Although this industry produces a considerable value in merchandise, the profits derived from it are exceedingly small, owing to wasteful and unorganized procedure.

In the following account of the process, which will be of interest to Europeans, I have followed the authority of Dr. Karl Mohr, of Mobile, the best-informed student of Southern resources, to whom I am also indebted for furnishing the exhibit.

Of the seven kinds of pine which prevail in the Southern States three are pitch pines proper, yielding large quantities of resinous products. These are *Pinus palustris* (long-leaf pine), *Pinus cubensis* (Cuban pine) and *Pinus tæda* (loblolly pine).

The first of these is the most important one, yielding the largest quantities of naval stores, which form so prominent a staple of Southern forests, although *Pinus iæda* is by no means an inferior producer. But since the former tree produces also the best timber of the Southern forest, and since on account of the devastation of the timber lands and wasteful use the entire destruction of the the long-leaf pine is only a question of time, *Pinus tæda*, which rapidly takes possession of worn-out fields and openings and enlarges its field of distribution, must be expected to become the principal future source of the turpentine industry. *Pinus cubensis*, which is confined in distribution, contains the smallest amount of resinous products, but is used where found together with *Pinus palustris.*

The industry of producing naval stores became important soon after the colonization of the State of North Carolina, but it was then confined to the region between Cape Fear and Tar River (Newberne and Wilmington). Eighty-eight thousand barrels of tar, pitch, and rosin are reported as the amount of exports at the end of colonial times. Since 1840 an extension of the industry took place southward to Florida and westward to Alabama, Mississippi, and Louisiana.

To run a distillery, which has usually a capacity of 300 gallons, requiring 20 barrels of resin daily, a turpentine orchard of 4,000 acres of timber land of best growth is required. This area is divided into 20 parcels or "crops" of 10,000 "boxes" each, *i. e.*, clefts in the trunks in which to collect the resin. Some of the trees, usually 12 to 18 inches in diameter, will bear two to four such boxes; therefore, 4,000 to 5,000 trees, which are usually found on 200 acres, form such a parcel. These clefts or "boxes" are made in winter, from the beginning of November, about 1 foot above ground, squarely across the trunk, slanting inwards, being 14 inches long and 7 inches deep, the trough so formed holding about one-fourth of a gallon. The ground for 2½ feet around each tree is cleared of the inflammable material, which, brought into heaps, is burnt in the spring to avoid danger from fire. But from this practice arise many destructive fires, killing the young growths and deteriorating the old, far beyond the area of the turpentine orchard.

With the beginning of spring the "chipping" begins, by peeling with an ax on both sides of the box a 2-inch strip 8 inches upward ("cornering"), and laying the area between the strips bare to the splint ("hacking," "chipping") with a special instrument called the "hacker," a strong knife with curved cutting-edge; a 5-pound iron bullet attached to the end gives additional strength to the knife, with which concave V-shaped cuts are made, slanting down from both sides. Every week several new cuts are made, by which the scar increases during the month 1½ to 2 inches.

This operation ("chipping") begins in the middle of April and lasts until the middle of Octobar, end if warm weather permits until November. One workman attends to 10,000 boxes during the season. The boxes fill during the first and third year on the average every four weeks, and are emptied with a flat ladle (dipping). This dipping is done six times during the season, and the dippings are sent in barrels to the distillery. The yield of 10,000 boxes at every dipping is 40 to 50 barrels, con-

taining 280 pounds each of rosin (turpentine), or 300 barrels to the crop. They are dipped 6 times. If the exudation becomes slow at the approach of cold weather, the surface and box are carefully cleaned with a scraper of the hardened rosin ("scrape"). This scrape is of poor quality, dark color, impure with pieces of wood, etc.; 70 to 75 barrels of this are made each season for the first two years.

The rosin of the first two months (virgin dip), of almost white color, is the finest quality—water-white or window-glass (W. G. or W.).

The next best qualities of the first season, of slightly yellow (straw) color, are designated N, M, and K. The quality is judged from the color, and the letters of the alphabet are used to designate the same in series; so that A is the poorest, N the best quality next to W. To get the latter quality, great care is necessary in the control of the fire and in keeping impurities out.

The grades, then, are: W, window-glass; N, extra pale; M, pale; K, low pale; I, good No. 1; H, No. 1; F, good No. 2; E, No. 2; D, good strain; C, strain; B, common strain; A, black.

The spirits of turpentine made from the different grades of rosin are also different; the best grade yields a tasteless product, light in weight and of light color; the lower grades yield a more resinous product, of biting taste and greater weight, due to the rosin distilling over under the greater heat necessary.

During the first year the average yield is: Dip, 270 barrels, containing 280 pounds; scrape, 70 barrels. The former distills 7 gallons of turpentine, the latter 3 gallons per barrel. The market-product result, therefore, is 2,200 gallons, or 50 barrels, containing 45 gallons of spirits of turpentine and 260 barrels of rosin.

The second year the chipping is continued, so that the scar is enlarged by 16 inches; yet the yield of the 10,000 boxes is about 10 barrels less than the first year, while the scrape increases to 120 barrels. The yield of spirits of turpentine averages about 40 barrels, besides about 200 pounds of dark amber-colored rosin of the quality T. H. G.

The third year the quantity decreases again; the boxes are dipped only every six weeks, or four times during the season. The hacking or chipping is carried up sometimes to a height of 10 or 12 feet above the ground.

With the slower flow over a considerably enlarged surface the quality is inferior on account of evaporation and influence of the air; also, resinification of volatile parts. The yield of spirits of turpentine is decreased to 1,000 or 1,200 gallons, besides 100 barrels of rosin belonging to the dark-brown grades (F, E, D).

The fourth or last year the flow still decreases, the yield being 120 barrels of rosin and 125 barrels of scrape, which give 900 gallons of spirits of turpentine and 100 pounds of rosin of the lowest grades (C, B, A), which are of but little use and are mostly sold to soap-makers.

In the distillation each barrel (280 pounds of rosin) yields 5 gallons of spirits of turpentine. The yearly product of a tree is about 21 pounds. The total production, then, of such an orchard during the four years may be figured as follows:

120,900 gallons spirits of turpentine	$33,852
5,200 barrels rosin, best quality, at $2.90	15,080
4,000 barrels rosin, second grade, at $1.20 to $1.25	5,000
2,400 barrels rosin, ordinary, at $1 to $1.10	2,400
1,200 barrels rosin, poorest quality, no certain market value.	

Altogether somewhat over $56,300, or $280 per acre, or $10 or $14 per tree.

The wood on the land, if it can be sold to a neighboring market or mill, will yield 2,500 to 3,000 feet B. M., or 50 to 60 cords of firewood, per acre. The lumber obtained from these trees is probably not inferior for some purposes—inside work—to that of untapped trees, yet in most cases trees are not made into lumber.

The following table, taken from the census of 1880, gives the statistics of the industry for the year 1879:

States.	Turpentine.	Rosin.
	Gallons.	*Barrels.*
Alabama	2,005,000	158,482
Florida	1,036,350	68,281
Georgia	3,151,500	277,500
Louisiana	250,000	20,000
Mississippi	250,000	20,000
North Carolina	6,279,200	663,967
South Carolina	4,593,200	333,940
Total	17,565,250	1,542,170

In addition, 90,000 barrels of tar were manufactured. To yield these quantities in 1880 more than 3,000,000 acres of timber must have been in orchard; 600,000 acres being the estimate of new chippings during that year, producing one-fourth of the total crop.

The total value of the crop of naval stores at centers of distribution was estimated at $8,000,000. Yet the production of naval stores is carried on in a wasteful, extravagant manner, and the net profits derived from the business are very small, while the damage done to the forest is incalculable.

Exhibit XIX, furnished by the Tiffany Chemical Company of New York, illustrates a by-product of the forest hardly inferior in value to the resin product—various barks and materials used in tanning leather. It is estimated that the present tanning capacity of the country requires 3,000,000 cords of bark, or nearly so. Placing the average yield per acre at 10 cords, which is a high average, it would take the bark of 300,000 acres of hemlock and oak growth yearly to fill this requirement. How many acres of such growth are still to be had is unfortunately not known. But the need of greater economy in the use of the bark is already recognized by the large tanneries, and it is generally becoming the rule to have chemical analyses made of the tanning materials and to employ chemists in running the works. The old methods, which implied a wastage—mechanical and of tanning principle—amounting to upwards of 50 per cent, are being replaced by better methods, long in use in European practice.

Special attention is called to No. 612 of the exhibit, furnished by Messrs. Fayerweather & Ladew, leather manufacturers, of New York, which is probably the largest piece of tan bark ever exhibited. It measures 12 feet 9 inches in width, corresponding to a tree of about 4 feet in diameter, and 8 feet two inches in height. It is from the hemlock (*Tsuga canadensis*), which furnishes the great proportion of the tanning material for our American leather. Enormous quantities of this bark have been peeled in the Northeastern States, when the timber had to be left in the woods; but of late, the value of the latter having been discovered, much of it is utilized. The bark is almost entirely used for tanning sole leather, and in combination with oak for other leather. The principal objection to the use of hemlock in tanning upper leather is the red color, hardness, and want of pliability which it imparts.

Within the last few years the manufacture of hemlock extract has become an industry of considerable importance, thus concentrating the tanning principle into a form which bears more economical shipping. One ton of bark yields 400 to 640 pounds of extract, weighing 10 pounds to the gallon. The larger amount produced is shipped to Europe, to the amount of round $250,000 per year.

The oaks represent several species of varying value for tanning purposes, the chestnut or tan-bark oak being the principal one, the bark of which is easily peeled and handled, which fact probably adds to the preference given to it by the tanners.

There are as yet no tan-bark coppices in existence, and the material is all derived from old growths, since it would not pay to peel young trees. In addition, quite a quantity of sumac leaves are gathered for tanning purposes, and other vegetable tanning materials are at least experimentally applied.

The samples on exhibition, for which Messrs. Tiffany wish to acknowledge thanks to Messrs. Banning, Bissell & Co., Hans Rees' Sons, and Hoyt Bros., of New York, and to George T. King, of Richmond, Virginia, and the Daguscahonda Extract Works of Pennsylvania, have been analyzed by this firm, who are the largest concern of leather chemists and dealers in special materials for leather manufacture, with agencies in Great Britain, France, Germany, and various places in the United States.

These analyses give, in the quickest manner, an idea of the value of the different materials, showing the range of tanning values in the rossed barks as 10.30 to 13.76 per cent, and in the bark extracts as 29.34 to 57.33.

Chemical analyses of samples of tanning materials on exhibit.

	Per cent.
No. 612. Large slab of hemlock bark from primeval forest tree:	
Moisture	10.80
Insoluble matter	74.80
Soluble matter	14.40
Nontannin	3.20
Tannin	11.20
No. 613. Slab of white-oak bark:	
Moisture	11.70
Insoluble matter	72.07
Soluble matter	16.23
Ash	0.32
Nontannin	4.29
Tannin	11.62
No. 614. Slab of red-oak bark:	
Moisture	14.30
Insoluble matter	67.49
Soluble matter	18.21
Ash	0.39
Nontannin	6.02
Tannin	11.80
No. 615. Slab of chestnut-oak bark:	
Moisture	8.21
Insoluble matter	70.10
Soluble matter	18.20
Ash	0.68
Nontannin	3.76
Tannin	13.76
No. 616. Slab of black-oak bark:	
Moisture	8.20
Insoluble matter	77.61
Soluble matter	14.90
Ash	0.39
Nontannin	3.61
Tannin	10.19
No. 617. Slab of hemlock bark:	
Moisture	8.21
Insoluble matter	77.51
Soluble matter	14.28
Ash	0.38
Nontanin	3.60
Tannin	10.30
No. 618. Sample of Canaigre root:	
Moisture	9.97
Insoluble matter	63.03
Soluble matter	27.00
Ash	0.58
Nontannin	9.21
Tannin	17.21
No. 619. Sample of Virginia sumac (leaves):	
Moisture	7.32
Insoluble matter	55.79
Soluble matter	36.89
Ash	0.66
Nontannin	15.06
Tannin	21.17
No. 620. Sample of Virginia sumac (ground):	
Moisture	7.32
Insoluble matter	55.79
Soluble matter	36.89
Ash	0.66
Nontannin	15.06
Tannin	21.17
No. 621. Sample of sumac extract:	
Moisture	57.12
Solids	42.88
Nontannin	13.17
Tannin	29.71

Chemical analyses of samples of tanning material on exhibit—Continued.

	Per cent.
No. 622. Sample of sumac extract (extra):	
Moisture	54.37
Solids	45.63
Nontannin	10.07
Tannin	35.56
No. 623. Sample of chestnut-oak bark extract:	
Moisture	54.16
Solids	45.84
Nontannin	13.62
Tannin	32.22
No. 624. Sample of quercitron-bark extract:	
Moisture	44.89
Solids	55.11
Nontannin	15.27
Tannin	39.84
No. 625. Sample of quercitron-bark extract (extra):	
Moisture	51.95
Solids	48.05
Nontannin	14.62
Tannin	33.43
No. 626. Samples of liquid hemlock bark extract:	
Moisture	53.98
Insoluble matter	1.74
Soluble matter	44.28
Ash	0.79
Nontannin	14.15
Tannin	29.34
No. 627. Samples of solid hemlock bark extract;	
Moisture	19.57
Insoluble matter	2.68
Soluble matter	77.75
Ash	0.79
Nontannin	25.10
Tannin	51.86
No. 628. Sample of refined hemlock bark extract:	
Moisture	8.12
Solids	91.88
Nontannin	34.55
Tannin	57.33

To the cry of the alarmist, who fears an exhaustion of the forest supplies that once appeared inexhaustible, the reply is often made, that in the absence of forest supplies substitutes will make their appearance in due time. This may be possible and even probable in many cases; thus, for building purposes, mineral substitutes recommend themselves; for railroad ties, metal makes superior claims; coal has long supplied, at least partly, our needs for fuel; and so on. At the same time new uses for wood material have generally sprung up side by side with the substitute in other directions. The use of excelsior or wood wool is growing rapidly, the manufacture of cellulose consumes large quantities of wood, and the amount of wood used in paper manufacture is increasing daily. While, then, the use of paper for car wheels, manufacture of vessels, appears as a substitute, it is in reality simply extension of the application of wood and a change in the manner of application. The forester will take from this hint, not that his art will have to go begging, but that his aims and methods may have to be changed from those of the old masters. The method of treating soft and quickly grown woods so as to transform them into material useful for any application in which formerly hard woods of slower growth could only be utilized, may revolutionize his methods of forest culture.

Exhibit XX.—One of the methods lately come into use for utilizing wood material in a transformed state is exhibited in the display of Messrs. Cordley & Hayes, of New York, showing the different stages of manufacturing so-called indurated fiber ware. The material, a soft spruce log for instance, is ground into pulp and shaped roughly into the desired implement; and then, by special treatment (a secret process), hardened to resemble the hardest enamel ware, without liability to breakage or damage of any kind. The variety of application to which this process is capa-

ble will appear from the large exhibit of this firm in another part of the Exposition.

Exhibit XXI.—We come now to the last exhibit, which, although not strictly to be classified with forestry as an art or science, yet is a product unique, peculiar to the North American forest: A frame artistically arranged, showing some of the autumn tints which grace the North American landscape in unrivaled beauty and splendor. While it is impossible to preserve the richness and variety of color which is exhibited in the leaves as they are turned into all imaginable hues at the approach of winter, yet a faint conception will be possible from our small design of leaves encircling a photograph of the building of the United States Department of Agriculture at Washington.

CHAPTER XXX.

REPORT OF THE DIVISION OF ECONOMIC ORNITHOLOGY AND MAMMALOGY.

By C. HART MERRIAM,

The scope of the work of this division, as defined by act of Congress, is: "The promotion of economic ornithology and mammalogy; an investigation of food, habits, distribution, and migrations of North American birds and mammals, in relation to agriculture, horticulture, and forestry." The function of the division, then, consists in the collection of facts relating to the above subjects and the arrangement of these facts into special reports and bulletins.

The present report consists merely of a few tabulated results of special investigations upon the economic status of the house or English sparrow (*Passer domesticus*), common crow (*Corvus americanus*), fish crow (*Corvus ossifragus*), and red-tailed hawk (*Buteo borealis*). Except in the case of the English sparrow it relates exclusively to food, as determined by critical examination of stomach contents.

This report is accompanied by colored maps showing the distribution of several species of mammals and birds of special economic importance.

Table showing approximately the extension in square miles, in the United States, of the English sparrow, in periods of five years each, from 1870 *till* 1885, *and its extension during the year* 1886.

	Square miles.
From 1870 to 1875 it spread over	500
From 1875 to 1880 it spread over	15,640
From 1880 to 1885 it spread over	500,760
In the year 1886 it spread over	516,500

This table of necessity is largely theoretical, though the ratio of increase must be very nearly correct. Year by year much of the reproductive energy of the sparrow is expended in filling up the smaller towns and villages of the area, which, so far as the larger towns and cities are concerned, it covered some time previously.

Table showing the annual increase and total number of English sparrows, the progeny of a single pair, in successive seasons for ten years, assuming that all lived.

Years.	Number of pairs breeding.	Number of pairs of young.	Total number of pairs.	Total number of birds.
1	1	12	13	26
2	13	156	169	338
3	169	2,028	2,197	4,394
4	2,197	26,364	28,561	57,122
5	28,561	342,732	371,293	742,586
6	371,293	4,455,516	4,826,809	9,653,618
7	4,826,809	57,921,708	62,748,517	125,497,034
8	62,748,517	754,982,204	815,730,721	1,631,461,442
9	815,730,721	9,788,768,652	10,604,499,373	21,208,998,746
10	10,604,499,373	127,253,992,476	137,858,491,849	275,716,983,698

Stomach contents of adult crows (Corvus americanus) taken near Washington, District of Columbia, in winter.

No.	Date.	Percentages of elements.			Nature of contents.
		Animal.	Veg'ble	Mineral.	
1299	Dec. 19	1	80	19	Acorns, corn, etc.; seaweed; sumach seeds (*Rhus glabra*); pieces of insects.
1300	Dec. 19	0	90	10	Corn; seeds of grape, sumach (*Rhus glabra*), and of poison sumach and poison ivy.
1301	Dec. 19	Trace	75	24	Acorns, etc.; corn hulls; seeds of poison ivy and poison sumach; bits of insects.
1302	Dec. 19	1	85	14	Corn; seeds of *Rhus glabra*, and of poison ivy and poison sumach; few insect remains.
1303	Dec. 19	1	94	5	Kernels of corn; seeds of grape, of *Rhus glabra*, and of poison sumach and poison ivy; unknown seeds; bits of insects.
1304	Dec. 19	5	70	25	Kernels of corn; seeds of poison sumach; insect remains.
1311	Dec. 23	10	60	30	Wheat or corn; sumach seed (*Rhus glabra*); seaweeds; bits of mussels, small crustaceans, and insects.
1312	Dec. 23	40	50	10	Corn and corn hulls; seeds of sumach, *Rhus glabra* and *R. typhina* (?); remains of crayfish or crab; small fish-bones; remains of insects.

Stomach contents of adult crows (Corvus americanus) taken in Connecticut, New York, New Jersey, and Pennsylvania, in winter.

No.	Locality.	Date.	Percentages of food elements.				Nature of contents.
			Animal.	Vegetable.	Mineral.	Indeterminate.	
1518	New York....	Dec. 15	12	63	25	0	Corn, acorns, and other seeds; many insects.
2649	New Jersey...	Jan. 2	7	90	3	0	Corn; pumpkin and cucumber seeds; bits of mussel or clam.
4117	Connecticut ..	Dec. 15	15	60	20	5	Acorns; thorn-apple (*Cratægus*); bits of grass, etc.; hair of mouse; few insect remains.
4432	Connecticut ..	Jan. 15	10	75	15	0	Corn; seeds of sumach and poison ivy (*Rhus*); carrion.
4436	Connecticut ..	Jan. 16	35	60	5	0	Seeds of sumach, poison sumach, and poison ivy; carrion.
4438	Connecticut ..	Jan. 16	14	85	1	0	Corn; seeds of sumach; carrion.
4450	Connecticut ..	Jan. 31	5	48	47	0	Corn; carrion; few insect remains.
4452	Connecticut ..	Jan. 31	50	42	8	0	Acorns; seeds of sumach, poison sumach, and poison ivy.
4461	Connecticut ..	Feb. 14	40	50	10	0	Corn and other grain; seeds of sumach; unknown seeds; bits of grass, etc.; carrion.
7012	Pennsylvania.	Jan. 12	25	50	25	0	Corn; poison-ivy seeds; bones of small bird and of a small fish; beetles and other insects.

Stomach contents of adult crows (Corvus americanus) taken in the State of New York, in summer.

No.	Sex.	Date.	Percentages of food elements.				Nature of contents.
			Animal.	Vegetable.	Mineral.	Indeterminate.	
3045	.....	June —	3	95	2	0	Corn, oats, and wheat; a few bits of insects.
2514	F...	June 30	1	99	0	0	Corn; cherry-stones; acorn shells (?); bits of insects.
2516	M...	July 1	2	95	3	0	Corn; cherries; seeds of *Rubus* sp.?; unknown seeds; few insects.
2517	M...	July 1	65	33	2	0	Cherries; raspberry seeds; numerous insect remains.
2518	M...	July 1	70	30	0	0	Cherries; bones of small salamander; numerous insect remains.
2519	M...	July 2	60	40	0	0	Cherries; remains of frog.
2520	F..	July 2	50	50	0	0	Cherry-stones; insects.
2521	F...	July 2	60	40	0	0	1 cherry-stone; insects.
2522	F...	July 2	33	65	2	0	Cherries; frog-bones; insects.
2866	M...	July 14	60	30	4	6	Oats; grass and other vegetable fiber; bones and teeth of field-mouse (*Arvicola*); many insect remains.

Stomach-contents of young crows (Corvus americanus).

No.	Date.	Percentages of food elements. Animal.	Vegetable.	Mineral.	Indeterminate.	Nature of contents.
5510	May 13	90	0	0	10	Insects; bones of small frog.
5511	May 13	90	7	1	2	Insects, mostly beetles; small bits of acorns; 2 or 3 fish bones; bits of snail shell.
1370	May 23	99	0	1	0	Bones of frog; many bits of insects.
2677	June 27	95	5	0	0	Pieces of small insects; corn hulls.
2515	July 1	99	0	0	1	Insect larvæ; insects; bits of bark.
3760	July 1	15	10	75	0	Crab's leg; small fish bones; bits of insects; seaweed.
2678	July 4	10	90	0	0	Grain; berry seeds; insect larvæ; fish bones.
2679	July 4	3	97	0	0	Acorns (?); bits of flower; fish bones.
4886	July 15	10	45	45	0	Unknown seeds and berries; bits of insects.
4887	July 16	35	65	0	0	Caterpillar; seeds of raspberries; moss.
4888	July 16	1	99	0	0	Raspberries; strawberry seeds (?); bit of insect.

Stomach contents of adult fish crows (Corvus ossifragus) taken near Washington, District of Columbia.

No.	Date.	Percentages of elements. Animal.	Vegetable.	Mineral.	Nature of contents.
1310	Dec. 23	1	96	3	Wheat and other grain; seeds of red cedar (*Juniperus*); feathers and egg shells (of hen?).
1318	Dec. 25	50	50	0	Carrion; seeds of sour gum (*Nyssa*), dogwood (*Cornus florida*), hackberry (*Celtis*), and grape.
1332	Mar. 16	5	93	2	Carrion; corn; seeds of sour gum, and of *Smilax glauca*.
1334	Mar. 16	98	trace	2	Carrion; egg shell; vegetable fibers.
1335	Mar. 16	75	5	20	Carrion; egg shell; woody fiber.
2284	Nov. 1	65	30	5	Egg-shell; grasshoppers and other insects; grape seeds and skins.
2302	Nov. 7	35	65	0	Grape seeds and skins; seeds of pokeberry (*Phytolacca decandra*); grasshoppers and other insects.
2529	Nov. 1	10	90	0	About 20 pokeberries; several grasshoppers.
2583	Nov. 19	50	50	0	Seeds of pokeberries and red cedar (*Juniperus*); insect remains.

Table showing contents of 348 stomachs of the red-tailed hawk (Buteo borealis) arranged by months.

Month.	No. of specimens.	Poultry or game birds.	Other birds.	Mice.	Other mammals.	Reptiles or batrachians.	Insects.	Miscellaneous.	Empty.
January	97	8	11	149	16	1	10	1 crawfish; offal	2
February	48	2	1	86	5	....	1	1 crawfish; offal	7
March	67	3	17	62	18	5	7	2 crawfish	9
April	17	3	2	19	6	1	6	....	1
May	3	2	2	2	2	1	1	....	....
June	3	2	....	1	1	....	....	....	....
July	5	2	....	4	....	1	42	....	1
August	7	....	1	3	3	3	33	1 crawfish	....
September	6	....	....	3	1	6	2	....	....
October	9	....	4	11	5	....	1	....	....
November	37	5	2	30	6	1	6	Offal	8
December	49	7	3	65	9	....	1	Offal	8
Total	348	34	43	435	72	19	110	6 offal; 5 crawfish	36

CHAPTER XXXI.

MICROSCOPY AND FOOD ADULTERATIONS.

By THOMAS TAYLOR.

The exhibit of this division consists of microphotographs illustrating the varied crystalline formations of butter and other fats, the structural characteristics of some condiments, and several drawings of instruments used in the detection of food adulterations and textile fibers; also a working model of a new freezing microtome.

The exhibit of butter and other fats comprises one hundred and sixty-seven photographs of crystals of butter and over one hundred photographs of crystals of other fats, including beeswax and cotton-seed-oil stearin. The primary object of this investigation was the discovery of a means of discriminating between pure butter fat and imitations of it, in the course of which some of the characteristics of fats, other than butter, have been closely observed.

Butter, oleomargarine, butterine, or any other fat, highly heated and cooled slowly, will appear granular to the naked eye. These granules, viewed with plain transmitted light, are found to consist of thousands of minute crystals which arrange themselves in globose, arborescent, or stellate forms; and groupings of these viewed with polarized light, with or without selenite, are shown in the accompanying illustrations. In the United States boiled butter is not offered for sale; therefore in the United States, in all pure, unmelted butters viewed with polarized light, with or without selenite, the surface appears of an even color. In unmelted butter viewed with polarized light, without selenite, a dark surface is presented, provided the prisms are at right angles to each other; and this is also true of pure oil, free from particles of fat, viewed under the same conditions. Butter in the process of decomposition, having a strong odor of butyric acid, should not be considered as normal butter, as it contains free fatty acids. Such butters frequently show crystalline structure with polarized light. When subjected to a temperature of 100° C. these butters emit a strong odor of butyric acid, or decomposing casein, which has a cheesy odor. If a supposed butter contains foreign fats, such as beef-fat or lard, the odor on melting is generally that of beef-fat or lard.

It will be observed that Fig. 1, Plate 1, shows a rosette-like formation in the center of the butter crystal. This is observed in most butter crystals, and has been termed for the sake of convenience a secondary crystal, although there are indications that this so-called secondary may sometimes be the primary crystal, depending upon the age of the butter, method of cooling, etc. Figs. 10, 11, 12, Plate 1, I have termed for the sake of convenience tertiary crystals. The secondary crystals generally change, in the course of several months, to a third or tertiary form. Butter, if reboiled at this stage and cooled slowly at 60° F. (15.56° C.), will sometimes resume

the primary or globose form of crystals, but will again change in a few days, showing secondary and tertiary forms, especially if in a temperature of 70° F. (21.11° C). These changes are not observed in oleomargarine.

There are marked indications that certain breeds of milch cows, with certain varieties of feed, yield a butter-fat of distinctive crystalline characteristics, but this subject requires further investigation. It is probable that feed and breed modify the fatty glycerides of butter, producing a tendency to distinctive characteristics noted and illustrated in this exhibit. Butter crystals of the Holstein milch cow seldom exhibit secondary crystals, and are, in comparison with butter crystals of other breeds of cows, more transparent, requiring about half the usual time for exposure to light in photographing them or in printing with negatives. Negatives of butter crystals of the Shorthorn cow require an exposure to sunlight of about ten minutes. Pure lard resembles the butter crystals of the Holstein cow in respect of transparency.

Fats used in the composition of butter substitutes are generally lard and beef-fat, to which stearin is frequently added to give greater consistency to the compound. These fats are used in different proportions by manufacturers. Butterine is said to contain in some cases 25 per cent of butter. The fats of oleomagarine are churned with milk, thereby acquiring a small proportion of butter. Every sample of oleomargarine or other butter substitute thus far examined by me shows, with polarized light and selenite plate, crystallized fats, the shade of color depending upon the thickness of the plate and upon the relative angle of its optical axis with the plane of polarization. By means of selenite the observer may sometimes detect forms not otherwise discoverable.

An expert is seldom in doubt as to whether a suspected butter-like substance under inspection is butter or oleomargarine, from the fact that butter is seldom mixed with lard or beef-fat to any appreciable extent. As a rule, when a suspected butter has a bad odor it is rancid butter, but if it has a fresh appearance, is firm to the touch, and has little or no odor of butter and scarcely any butter taste, notwithstanding its resemblance to genuine butter, it is probably an oleomargarine.

The globose crystals of "oleo" are always smaller than those of butter, unless produced by the aid of chemicals.

EXHIBIT 1, Fig. 1, represents pure boiled butter with polarized light.
Figs. 2, 3, 4, 5, pure boiled butter with polarized light and selenite.
Fig. 6, oleomargarine with polarized light.
Fig. 7, oleomargarine with polarized light and selenite.

EXHIBIT 2, Figs. 1, 2, 3, 5, butter crystals of the Shorthorn breed.
Fig. 4, butter crystals of Shorthorn and Jersey, cross-breed.
Figs. 6, 7, 8, 9, secondary butter crystals.
Figs. 10, 11, 12, tertiary butter crystals.

EXHIBIT 3, secondary crystals of butter.

EXHIBIT 4, tertiary crystals of butter.

EXHIBIT 5, butter crystals of the Holstein milch cow.

EXHIBIT 6, Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, butter crystals.
Fig. 12, tertiary crystals of decomposing butter.
Figs. 13, 14, 15, 16, beef-fat crystals.
" 17, 18, crystals of "oleo" (extract of beef-fat).
" 19, 20, lard crystals.
" 21, 22, 23, 24, crystals of oleomargarine.

EXHIBIT 7, same as plate 6, with polarized light and selenite.

EXHIBIT 8, crystals of beef-feet.

EXHIBIT 9, crystals of pure lard.

EXHIBITS 10, 11, oleomargarine crystals.

EXHIBITS 12, 13, lard crystals in contrast with crystals of other fats.

EXHIBITS 14 to 23, inclusive, crystals of various butters.
EXHIBIT 24, crystals of human fat.
EXHIBIT 25, crystals of man and horse fats, in contrast.
EXHIBITS 26, 27, crystals of dog fats.
EXHIBITS 28, 29, 30, 31, fats of fish, fowl, etc.
EXHIBITS 32 to 41, inclusive, represent usual groupings of crystals of butter fats highly magnified, showing the changes that take place. The largest crystals average about one-hundredth of an inch in diameter.
EXHIBITS 42, 43, 44, represent beef-fat crystals. The detail of outline is more perfect in plate 42 than in plates 43 or 44. Each crystal is magnified from five to eight hundred diameters.
EXHIBIT 45, crystals of human fat (*Omentum*) x 50.
EXHIBIT 46, crystals of muskrat fat (*O. zibethicus*) x 140.

CONDIMENTS.

In microscopic investigations of condiments for the purpose of ascertaining peculiarities of cell structure, I find it necessary to steep the berry, root, or seed in water for about twenty-four hours, after which it may be cut in sections suitably fine, of various grades of thickness, at various angles, for the study of its special characteristics under the microscope. The respective layers should be viewed with plain, transmitted, and polarized light. On subjecting the epidermal layer of white mustard-seed to polarized light I have discovered that every cell of which the layer is composed is not only a polarizing body, but that each shell very unexpectedly shows a well-defined cross, thus resembling starch granules. I believe this feature has not heretofore been observed, and but for this discovery such bodies might be mistaken for an adulterant, as mustard seed, white or black, is known to be destitute of starch. Ground olive stones and cocoanut shells, said to be largely used in the adulteration of some of the condiments, may be purchased cheaply in large quantities. These powders so closely resemble white pepper that they can only be detected by the microscope. In making these investigations I photograph the sections of the berry, root, or seed and make tracings of such parts as are necessary.

My next step is to reduce the condiments to powder and observe them under high and low powers, with and without polarized light and selenite plate, comparing them with the commercial samples. Many observations are required to ascertain whether a foreign substance observed in any sample is there by accident or in such quantity as to indicate a fraudulent purpose. For legislative and judicial purposes it is not of so much importance to ascertain what precise adulterant is used, provided it be harmless, as it is to ascertain how much is used, as this determines whether the material has been added with fraudulent intention. Experts allow but 1 per cent for accidental adulteration.

EXHIBITS 47, 48.—*Black pepper:*

1. Longitudinal section of berry.
2. Starch cells.
3. Oil cells.
4. Pure ground black pepper.
5. Black pepper adulterated with olive stone powder.

A. Sclerenchyma cells of powdered cocoanut shells.
B. Individual sclerenchyma cells of olive stone powder.

EXHIBITS 49, 50.—*White mustard:*

1. Seed, natural size.
2. Plantlet, partially dissected.
3. Epidermal layer.—(*a*) Central tube of a cell of Fig. 3 highly magnified; (*b*) Spiral ducts.

4. A second layer.
5. A third layer.
6. A fourth layer.
7. Layer of oil cells.
8. The same as Fig. 7, highly magnified. Oil globules enlarged by aggregation by the action of sulphuric acid.
9. Same layer as 7, in which the plantlet is originally embedded.
10. Pure mustard in powder.
11. Adulterated mustard showing starch granules.

EXHIBITS 51, 52.—*Cloves:*

1. Clove bud, natural size.
2. Transverse section of clove bud, highly magnified.
3. Sclerenchyma cells of ground cloves.

EXHIBITS 53, 54.—*Allspice:*

1. Longitudinal section, natural size.
2. Highly magnified view of same.

3, 4. Sclerenchyma cells of ground allspice.

EXHIBITS 55, 56.—*Cinnamon:*

1. Longitudinal section of bark.
2. Large, spindle-shaped tubular cells.
3. Cross section view of same.
4. Individual sclerenchyma cells common to pure cinnamon.

EXHIBITS 57, 58.—*Black mustard:*

1. Seed, natural size.
2. Epidermal layer.
3. A second layer.
4. A third layer. oil cells.
5. The same layer highly magnified. Oil globules greatly enlarged by aggregation by the action of sulphuric acid.
6. A layer of cells over and in contact with the oil cells.
7. Pure mustard.
8. Adulterated mustard showing starch granules, never found in pure mustard.

EXHIBIT 59:

Taylor pocket polariscope. (Oleomargariscope.)

In the prosecutions for violations of the butter laws of the District of Columbia a simpler form of instrument seemed desirable than the cumbrous stand with polariscope in general use by microscopists, in order that the parties interested in the examinations might readily see for themselves the crystalline forms of the fatty compounds sold in imitation of pure butter. To this end the instrument invented by Thomas Taylor, M. D., microscopist United States Department of Agriculture, has been adopted.

EXHIBIT 59.—Fig. 1. Appearance of the instrument when not in use.

Fig. 2. Sectional drawing showing the interior arrangement of the pocket polariscope: *a* Eyepiece; *b* objective, $\frac{1}{2}$ inch; *c* analyzer or Nicol prism; *h* polarizer, which may be rotated to change the colors; *f* two discs of thin plate glass between which the butter or oleomargarine is placed. The fats used should be slightly compressed to admit the passage of light. *g* Selenite plate; *i* lens for the purpose of illuminating the polarizer and protecting it from particles of dust.

The objective is focused by means of the drawtube. Hold the object up to a strong light. If the butter is normal, an even green or red color only will be observed, depending upon the character of the selenite plate. If the material under examination is "oleo," or lard instead of normal butter, a fine display of prismatic

colors will be observed. So successful has this little instrument proved in practice that it is now coming into general use. Agents of the United States Bureau of Interal Revenue are being furnished with pocket polariscopes by the Chief of the Bureau.

EXHIBIT 60.—Taylor combination freezing microtome.

The freezing microtome invented by Dr. Thomas Taylor, United States Department of Agriculture, supplies a long-felt want. The instrument, as its name implies, combines the valuable properties of several microtomes, by means of which vegetable or animal tissues may be quickly frozen, using ice water and common salt, ether, or rhigolene. Tissues embedded in wax or paraffin may be as readily cut. Notwithstanding its several adaptations the arrangement is remarkably simple consisting of an adjustable knife (curved in this illustration, although a straight knife may be used) and a freezing chamber which when removed admits of the substitution of a cork or other suitable substance on the top of which the material to be cut in section is held by means of paraffin or wax.

EXHIBIT 60.—*x* represents the freezing chamber, a metallic box with arms, to both of which rubber tubing is affixed for the access and exit of water or ether. The exit tube is furnished with a glass tube terminating in a bore one-sixteenth of an inch in diameter, which prevents a too rapid flow of the freezing liquid. This passing into a separate vessel may be used over again, especially if freezing water. Ether may be condensed in ice water in a close jar and thus reserved for future use, a precaution hitherto overlooked. *x'* A sectional view of the freezing chamber; *s* the revolving table. The freezing chamber is prevented from turning by a back plate, facing the mahogany block, which arrests the movement of the arms coming in contact with it.

EXHIBIT 61.—Taylor instrument for testing the tensile strength of textile fibers.

CHAPTER XXXII.

FUNGUS DISEASES OF PLANTS.

By B. T. GALLOWAY.

The Section of Vegetable Pathology was organized in July, 1887. Its purpose is to investigate the causes of and remedies for the diseases of cultivated plants caused by parasitic fungi, and to disseminate information concerning them. The first has been done by the work of specialists in the laboratory and in the field, and the second by the publication of bulletins and annual reports, both illustrating and describing the fungi causing these diseases. In these there are always suggestions as to treatment, and especial attention has been given to any experiments with fungicides which have been made by the Department or reported to it by outside parties. The fact that a successful remedy has been found for black rot of the grape, and that there are indications that bitter-rot and scab of apples as well as other destructive diseases may also be prevented, is sufficient to show that the section is of practical value to the country.

The following illustrations and photographs of the leading fungus diseases of cultivated plants, together with maps indicating distribution, comprised the exhibit of this section at the Exposition.

ILLUSTRATIONS OF FUNGI.

No. 1.—*Apple scab* (*Fusicladium dendriticum*, Fckl.).

Fig. 1. Diseased apple.
Fig. 2. Leaf with spots caused by the fungus.
Fig. 3. Spores, some of which are germinating.
Fig. 4. Section of a diseased portion of the fruit.

The distribution of the disease is coextensive with the cultivation of the apple. It is found in nearly every orchard in the Eastern and Central States and is frequent in California; has been known in Europe for over fifty years, and is a serious pest in Australia and New Zealand.

It attacks certain varieties more than others, but in some seasons respects neither soil, culture, nor variety. In the United States it causes great annual losses, to the extent of one-half the crop in some States.

No. 2.—*Cotton leaf-blight* (*Cercospora gossypina*, Cke.).

Fig. 1. Tuft of spore-bearing hyphæ, with detached spores.
Fig. 2. End of branch with diseased leaves.

One of several fungi that infest the cotton plant; probably occurs in all the cotton-growing States. It is more prevalent in wet weather, and is sometimes sufficiently serious to materially diminish the vitality of the plant.

No. 3.—*Pear leaf-blight* (*Entomosporium maculatum*, Lev.).

Fig. 1. End of branch with diseased leaves.
Fig. 2. Diseased fruit, showing crack.

The fungus attacks the leaves, stems, and fruit, sometimes defoliating the trees as early as the middle of July, and causing the fruit to crack, as shown in the figure. It is widely distributed, and in some places destroys three-fourths of the crop annually.

No. 4.—*Strawberry leaf-blight* (*Sphærella fragariæ*, Tul.).

Fig. 1. Diseased strawberry leaf.
Fig. 2. Germinating summer spores.
Fig. 3. Several asci with a portion of the pseudoparenchyma to which they are attached.
Fig. 4. Ascospores, much enlarged.
Fig. 5. Section through the upper surface of a leaf, showing a tuft of conidiophores with spores attached.
Fig. 6. Section of a perithecium, showing asci within.
Fig. 7. Perithecium, external view, with conidiophores and conidia at the apex.

The injury to strawberry culture resulting from this disease appears to have been on the increase during the past 5 or 6 years. It seems to be pretty thoroughly distributed throughout the United States, and appears to be most severe in Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, Kansas, and Kentucky.

Its effects, even in mild cases, must be detrimental to the processes of assimilation, and when the attack is severe it results in the death of the plants.

No. 5.—*Cedar apples, and apple Rœstelia*, (*Gymnosporangium macropus*, Link.).

Fig. 1. Leaves showing the rust spots on upper and under surfaces.
Fig. 2. Cedar apples.

A disease which appears in different forms on different hosts, producing the growth usually known as cedar apples on cedar trees, and apple rust on the cultivated apple. It is a widespread disease and the injury which it does to apple trees seems to be on the increase. It attacks the fruit as well as the leaves.

No. 6.—*Orange leaf-scab* (*Cladosporium*, sp.).

Fig. 1. End of a twig bearing leaves attacked by the "scab."
Fig. 2. Portion of the leaf magnified, showing "scab" spots.
Fig. 3. Section through a scab spot, showing fungus on the surface.

Orange scab is a disease of recent appearance in the South, and is usually confined to sour stocks and lemons. It is very destructive to the growth of trees and ruinous to young nursery stock.

No. 7—*Anthracnose of the bean* (*Glœosporium lindemuthianum*, Sacc. & Mag.).

Fig. 1. Diseased pods.
Fig. 2. Section through a diseased pod, the dark portions representing the diseased spots.
Fig. 3. Section through a diseased pod in a more advanced stage of the disease, one side of the pod and the bean within being completely shriveled.
Fig. 4. Section through a pustule containing the basidia and spores of the fungus.
Fig. 5. Spores.

The disease sometimes called "rust" attacks wax or butter beans, and often causes serious injury to melons by attacking the leaves and rind.

It occurs in Germany, France, Italy, England, and the United States. In the

latter country it seems to be very generally distributed, as specimens have been sent to the Department of Agriculture from Maine, Massachusetts, Wisconsin, Pennsylvania, Louisiana, and the District of Columbia.

No. 8.—*Black spot of the peach* (*Cladosporium carpophilum*, Thüm.)

Fig. 1. End of twig bearing diseased leaves.
Fig. 2. Diseased peach with crack caused by the fungus.

The peach spot is so prevalent and so uniformly present on certain varieties that some peach-growers consider it as a portion of the peach itself. It may and does cause serious injury in many cases. When it covers any considerable portion of the surface of the fruit it retards the growth of the outer parts and causes it to crack, thus making it very liable to decay.

No. 9.—*Rose rust* (*Phragmidium mucronatum*, Wint.).

Fig. 1. Diseased stem and leaves. Æcidium stage. Stem showing characteristic bend caused by the fungus.
Fig. 2. Diseased leaf, showing *Uredo* and *Phragmidium* stages.
Fig. 3. Section through a diseased spot on the back of a vein, showing the spores in rows. Æcidium stage.
Fig. 4. Æcidium and Uredo spores.
Fig. 5. Phragmidium spores.
Fig. 6. Section through a diseased spot, Uredo stage.

A fungus belonging to the same class as the one causing the apple rust, but, unlike that, producing all the different forms on the same plant. The disease is especially severe on hardy hybrid perpetuals. It is common in Europe and widely distributed in the United States, where it has recently been observed in California.

No. 10.—*Spot disease of the maple* (*Phyllosticta acericola*, C. & E.).

Figure showing both the upper and under side of the leaves of the silver maple attacked by the parasite.

The disease attacks both the red and the silver maples, sometimes rendering the foliage unsightly. It is especially severe on nursery stock. Found in the Eastern and Western States.

No. 11.—*Anthracnose of the raspberry* (*Glœosporium venetum*, Speg.).

Fig. 1. Diseased branch, showing the diseased spots on the stem, leaves, and petioles, and the effects on the berries.
Fig. 2. Spores, two of which have sent out germ tubes.
Fig. 3. Section through a disease spot on the stem, showing the manner in which the fungus breaks down the tissues.

This disease, sometimes popularly known as "raspberry cane rust," has caused serious injury in Illinois, New Jersey, Texas, Wisconsin, and Missouri. In southern Missouri the loss amounted to from 10 to 12 per cent in 1887.

No. 12.—*Black spot of the rose* (*Actinonema rosæ*, Fr.).

Fig. 1. Diseased leaf.
Fig. 2. Enlarged portion of a leaf at the edge of a black spot, showing the mycelium and two fruit pustules of the fungus.
Fig. 3. A strand of mycelium.

No. 13.—*Black spot of the rose* (*Actinonema rosæ*, Fr.).

Fig. 1. Section through a healthy rose leaf.
Fig. 2. Section through a leaf in the early stage of the disease, showing a pustule containing the spores of the fungus, and the mycelium in the epidermis.
Fig. 3. Section of a diseased leaf in a more advanced stage, showing mycelium in the tissues.

The disease is very widespread, occurring in nearly all the countries of Europe as well as in the United States. Moss roses and those with thick rough leaves seem to suffer more than other kinds, but few if any varieties are invulnerable to the parasite. The effect of the disease, besides the unsightly appearance which it imparts to the plants, is to cause a premature fall of the leaves, thus decreasing the assimilating power of the plant.

No. 14.—*Cherry rot* (*Monilia fructigena*, Pers.).

Fig. 1. Upper and lower sides of diseased leaves.
Fig. 2. Green and diseased cherries, some of the latter with the blossom clinging to them. Above is one which has hung on from the year before.

Rot of cherry is a disease both widespread and serious. It is very dependent on moisture for its development, but in a favorable season may entirely ruin the cherry crop on any tree that it attacks. The same disease attacks the apple, pear, peach, and plum.

No. 15.—*Potato rot* (*Phytopthora infestans* DBy.).

Fig. 1. Disease of the leaves.
Fig. 2. Section of a diseased tuber.

No. 16.—*Potato rot* (*Phytopthora infestans* DBy.)

Fig. 1. Undersurface of leaf epidermis showing two conidiophores with conidia attached projecting from a stoma.
Fig. 2. Conidium.
Fig. 3. Conidium, showing vacuoles, after being for a short time in water.
Fig. 4. Condition, with contents segmented, after remaining in water for a longer time.
Fig. 5. Zoöspores escaping from a conidium.
Fig. 6. Zoöspores, motile stage.
Fig. 7. Different stages in the germination of zoöspores.
Fig. 8. Germinating zoöspore in the act of sending a germ tube through a stoma.
Fig. 9. Section through a diseased leaf showing the mycelium in the tissues and conidiophores projecting through a stoma.

Downy mildew or rot of the potato is a disease known in nearly every State and Territory of the Union. It attacks both the leaves and tubers, and continues its ravages after the potatoes are stored for winter. It is dependent on moisture for its development, but in wet seasons it sometimes completely destroys the crop.

No. 17.—*Powdery mildew of the grape* (*Uncinula ampelopsidis* Peck).

Probably the same disease formerly known as *Oidium tuckeri*. It attacks both leaves and fruit, but does not usually cause very serious losses in the United States; in other countries it is more injurious. It occurs in nearly all parts of the United States, but is abundant only in limited areas.

No. 18.—*Erinose* (*Phytoptus vitis*).

A gall caused by insects instead of fungi. The appearance of the leaf is much like that produced by *Peronospora*.

No. 19.—*Spanish measles of the grape.*

Fig. 1. Leaf spotted with red.
Fig. 2. Leaf spotted with yellow.

No. 20. —*Spanish measles of the grape.*

Branch with diseased leaves.

A disease prevalent in California; cause unknown. Is destroying large vineyards.

No. 21.—*Downy mildew of the grape* (*Peronospora viticola* DBy.).

Distributed over nearly all the parts of the United States east of the twenty-ninth parallel of longitude. Very destructive in wet weather, the losses sometimes exceeding 75 per cent. It is even more troublesome in France.

No. 22.—*Septosporium on grape.*

A disease which was just discovered in the United States in the summer of 1887. As yet it occurs only on wild vines and has been found only in California. It is a distinct species from *S. fuckelii.*

No. 23.—*Black rot of the grape* (*Læstadia bidwellii* V. & R. Ellis).

Fig. 1. Disease on the stem and leaves.
Fig. 2. Disease spot more highly magnified.

No. 24.—*Black rot* (*Læstadia bidwellii* V. & R. Ellis).

On fruit.

No. 25.—*Black rot of the grape* (*Læstadia bidwellii*).

Fig. 1. Section through a pycnidium and spermogonium.
Fig. 2. Pycnidio spores.
Fig. 3. Section through a perithecium, showing asci in position.

A disease common to both continents. Its destructive powers are only too well known. In the United States it is found nearly everywhere east of the Rocky Mountains, and often destroys 90 per cent of the crop. Like many other fungous diseases it is comparatively harmless in very dry seasons and especially destructive in wet ones.

MAPS.

No. 1.—*Map showing distribution of Peronospora viticola in the United States.*

Legend.—The color indicates territory presumably infected. The circles denote districts from which the mildew has been reported. The numerals represent degrees of severity in bad seasons : 1, Slight losses, in no case over 25 per cent ; 2, considerable losses, especially in certain varieties ; 3, severe losses, in no case less than 75 per cent.

No. 2.—*Map showing the distribution of black-rot of the grape in the United States.*

Legend.—The color indicates the territory presumably infected. The circles denote districts from which reports have been received. The numerals represent degrees of severity in seasons favorable to the rot : 1, Losses ranging from slight to 25 per cent ; 2, losses ranging from 25 per cent to 75 per cent ; 3, losses ranging from 75 per cent to 100 per cent.

No. 3.—*Map showing the distribution of the peach and of peach yellows in the United States.*

Legend.—Climate suited to the peach, light color.

In the area north of this belt and in the Rocky Mountain region the peach is seldom cultivated on account of severe winters.

On the lowlands in the area south of this belt the peach is cultivated only to a limited extent, on account of the excessive prolonged moisture or heat of the growing season.

Principal peach districts, dark color.

Districts known to be affected by the "yellows" = = = = =

The figures in bold face denote the number of acres of peach orchard in each State, which, unless otherwise stated, are from the returns of the Tenth Census. ? denotes that the number of acres in the State is not known.

No. 4.—*Map showing the distribution and severity of potato rot in the United States in 1885, and also approximately the distribution of the potato itself.*

Legend.—Dark color, product of 149,000,000 bushels in 1879; light color, product of 18,000,000 bushels in 1879; white, product of 3,000,000 bushels in 1879.

The inclosed areas represent districts from which reports have been received; the counties in which the reported per cent of rot was about the same being grouped together.

The heavy black figures represent the average per cent of rot within each area.

The small figures indicate the number of reports received.

In most cases each report is an average derived from the statement of many individuals.

No. 5.—*Map showing the distribution of pear blight in the United States.*

Legend.—Light color, region affected by the pear blight; dark color, region where there is most loss from blight.

PHOTOGRAPHS OF PEACH YELLOWS.

No. 1.—*Healthy terminal peach shoot from Delaware.*

Photographed August 20, 1888. Reduced to about one-half natural size, *i. e.*, larger left-hand leaf was 2 inches broad and 8 inches long. Growth strictly comparable with No. 2.

No. 2.—*Peach yellows—Diseased terminal shoots from a Delaware orchard.*

Photographed September 27, 1887. Reduced to about one-half natural size. The growths upward from *a* and a' took place during one season. Many small branches were cut from the center to give a clearer view. Strictly comparable with No. 1.

No. 3.—*Healthy terminal peach shoots from Michigan—Winter appearance.*

Photographed March, 1888. Reduced to about one-tenth natural size. Strictly comparable with No. 4.

No. 4.—*Peach yellows—Diseased terminal shoots from a Michigan orchard—Winter appearance.*

Photographed May, 1888. Enlarged slightly, the actual length of the main axis in right-hand shoot being 10 inches. Shoots entirely dead. Comparable with No. 3.

No. 5.—*Delaware peach tree in second year of yellows.*

Photographed August 27, 1888. Tree 7 years old and about 16 feet in height; barren; foliage much dwarfed and yellow; base of limbs grown up with diseased shoots. Tree stands near healthy trees and was much less affected the previous year.

No. 6.—*Delaware peach orchard ruined by yellows.*

Photographed August 28, 1888. Trees 8 years old; set 20 feet apart; third and fourth year of disease. The tree in the foreground is entirely dead. The wiry growths on the limbs are very characteristic and are often the last indication of vitality.

No. 7.—*Maryland peach orchard ruined by yellows.*

Photographed November 7, 1888. Trees 8 years old; 20 feet apart. Diseased three to five years and only recently cut down; forms part of a large orchard, nearly all of which is badly diseased. Photographs V, VI, VII show three stages of the disease. A stage earlier than V, and characterized by the appearance of red spotted, prematurely ripened fruit, can not be shown satisfactorily by photographs.

CHAPTER XXXIII.

STATISTICS OF THE AGRICULTURE OF THE UNITED STATES.

By J. R. DODGE.

For the information of visitors to the *Exposition Universelle* of 1889, a statistical and cartographical exhibit of the resources of the United States, the production and distribution illustrating its agriculture was deemed appropriate and useful, was duly made, and will be briefly described in this report.

A series of four large maps of the United States is presented, illustrating the progress of twenty-eight years in the growing of cereals, cotton, and tobacco, and showing the distribution of each product, by States, at three different dates.

The diagrams, sixteen in number, show the local variation in rate of production of some of the principal crops, and the annual variation of the aggregate product; the relation of price to production, and the proportion of products exported. It also shows the distribution and increase of farm animals, the annual exportation of beef products, and the aggregate values by decades of all exports of beef and beeves, and the course of exportation of swine products. Among other points of illustration are the rates of wages of farm labor, by groups of States, the values at different dates of principal products, and a classification of agricultural and non-agricultural products in the foreign trade of the country, including both exports and imports. The progress of railroad building is also shown, from 1850 to the present time.

In prefacing the statements of statistical data upon which this graphic illustration is based, it may be desirable to outline the physical resources of the country, and present a few salient points in its agricultural development and present status. The total land surface of the United States is about 3,600,000 square miles. Exclusive of the unorganized Territory of Alaska, the official record is 1,856,108,800 acres, or 2,900,170 square miles. At least one-third of this area is divided into farms. In 1880 the proportion was 289 in every 1,000 acres; the number, 4,008,907, of the average size of 134 acres. In 1870 the average size was 153 acres; in 1860, 199 acres. The tendency is toward smaller farms. A larger part of the existing farm area is more productive than formerly; that which is known as "improved land" arable or in grass, constituted 40.1 per cent in 1860, 46.3 in 1870, and 53.1 in 1880.

The production necessary for the subsistence of 63,000,000 people, with some surplus annually for foreign consumption, is obtained by a partial use of a third of the territory. The methods in use in large areas of the national domain are primitive, employing a minimum of labor and a maximum of implements and machinery. As the public lands are virtually given away, any head of a family being able to obtain a homestead of 160 acres at no expense beyond the land-office fees, the acquisition of land which rapidly acquires value with the settlement of its vicinage is of more importance than good farming, of more immediate importance than progressive agriculture. Production is therefore small compared with its possibilities under conditions of progress inevitable in the future. In the older sections of the country scientific agriculture is more general, and the rate of yield increasing.

A tract of about 700,000,000 acres, included in what is designated the arid region, is extremely fertile, with insufficient rainfall for general agriculture. Irrigation, either actual at present or certain in the future, is all that is needed to insure large crops. It is probable that there will be a large increase of available water supply by the construction of a system of reservoirs, in the higher elevations of the Rocky Mountains, for the retention of waters now wasted by spring floods, which will further help to make this part of the country a reliable and abundant resource for the food supply of a dense population.

The distribution of the population shows about 44 per cent employed in agriculture. At the present time there are nearly 9,000,000 of farmers and farm laborers. The proportion is gradually decreasing, as manufacturing and mining industries are developed and extended. The fertility of the soil, improvement in rural methods, and wonderful advance of invention in increasing the productive power of labor by the use of labor-saving implements, insure an increasing measure of production for each producer employed and a release of rural labor for employment in other industries.

The first numbers of the graphic series are maps of the United States which show, by States, the quantity of wheat, corn, oats, cotton, and tobacco grown at the different dates mentioned.

No. 1.—*Wheat distribution in the United States, crops of* 1859, 1879, *and* 1887.

States.	1859.	1879.	1887.
	Bushels.	*Bushels.*	*Bushels.*
Alabama	1,218,444	1,529,657	1,305,000
Arizona		136,427	303,000
Arkansas	957,601	1,269,715	2,290,000
California	5,928,470	29,017,707	30,429,000
Colorado		1,425,014	2,514,000
Connecticut	52,401	38,742	37,000
Dakota	945	2,830,289	52,406,000
Delaware	912,941	1,175,272	929,000
District of Columbia	12,760	6,402	
Florida	2,808	422	
Georgia	2,544,913	3,159,771	2,522,000
Idaho		540,589	1,120,000
Illinois	23,837,023	51,110,502	36,861,000
Indiana	16,848,267	47,284,853	37,828,000
Iowa	8,449,403	31,154,205	26,837,000
Kansas	194,173	17,324,141	7,607,000
Kentucky	7,394,809	11,356,113	11,113,000
Louisiana	32,208	5,034	
Maine	233,876	665,714	481,000
Maryland	6,103,480	8,004,864	5,797,000
Massachusetts	119,783	15,768	16,000
Michigan	8,336,368	35,532,543	21,672,000
Minnesota	2,186,993	34,601,030	36,299,000
Mississippi	587,925	218,890	313,000
Missouri	4,227,586	24,966,627	27,744,000
Montana		469,688	1,760,000
Nebraska	147,867	13,847,007	16,585,000
Nevada	3,631	69,298	111,000
New Hampshire	238,965	169,316	110,000
New Jersey	1,763,218	1,901,739	1,459,000
New Mexico	434,309	706,641	1,221,000
New York	8,681,105	11,587,766	10,137,000
North Carolina	4,743,706	3,397,393	5,094,000
Ohio	15,119,047	46,014,869	35,895,000
Oregon	826,776	7,480,010	16,100,000
Pennsylvania	13,042,165	19,462,405	13,785,000
Rhode Island	1,131	240	
South Carolina	1,285,631	962,358	1,233,000
Tennessee	5,459,268	7,331,353	9,595,000
Texas	1,478,345	2,567,737	5,450,000
Utah	384,892	1,169,199	1,971,000
Vermont	437,037	337,257	320,000
Virginia	13,130,977	7,826,174	4,832,000
Washington	86,219	1,921,322	8,345,000
West Virginia		4,001,711	2,840,000
Wisconsin	15,657,458	24,884,689	13,063,000
Wyoming		4,674	
Total	173,104,924	459,483,137	456,329,000

Between 1859 and 1879 wheat growing received a marvelous impetus from a combination of powerful causes—an increase of 60 per cent of population, the wastes of a civil war in which millions of armed men were engaged in the early years of this period, and on the rising of an extraordinary foreign demand in later years. That demand declining somewhat, the production of the last decade has remained without material change. While wheat is grown in nearly all the States, its distribution, as shown in the map, is very unequal. Six-tenths of the crop is produced in twelve of the forty-seven civil divisions. From three-fourths of them no wheat of any importance enters the avenues of commerce, while most of them find it necessary to supply deficiencies from the principal wheat-growing States.

No. 2.—*Corn distribution in the United States, crops of* 1859, 1879, *and* 1887.

States.	1859.	1879.	1887.
	Bushels.	*Bushels.*	*Bushels.*
Alabama	33,226,282	25,451,278	33,522,000
Arizona	....	34,746	59,000
Arkansas	17,823,588	24,156,417	41,367,000
California	510,708	1,993,325	4,708,000
Colorado	....	455,968	938,000
Connecticut	2,059,835	1,880,421	1,977,000
Dakota	20,269	2,000,864	20,992,000
Delaware	3,892,337	3,894,264	4,332,000
District of Columbia	80,840	29,750	....
Florida	2,834,391	3,174,234	4,816,000
Georgia	30,776,293	23,202,018	32,067,000
Idaho	....	16,408	56,000
Illinois	115,174,777	325,792,481	141,080,000
Indiana	71,588,919	115,482,300	71,400,000
Iowa	42,410,686	275,014,247	183,502,000
Kansas	6,150,727	105,729,325	76,547,000
Kentucky	64,043,633	72,852,263	57,840,000
Louisiana	16,853,745	9,889,689	18,022,000
Maine	1,546,071	960,633	1,132,000
Maryland	13,444,922	15,968,533	19,415,000
Massachusetts	2,157,063	1,797,768	2,124,000
Michigan	12,444,676	32,461,452	18,930,000
Minnesota	2,941,952	14,831,741	18,081,000
Mississippi	29,057,682	21,340,800	32,633,000
Missouri	72,892,157	202,414,413	140,949,000
Montana	....	5,649	25,000
Nebraska	1,482,080	65,450,135	93,150,000
Nevada	460	12,891	24,000
New Hampshire	1,414,628	1,350,248	1,323,000
New Jersey	9,723,336	11,150,705	10,406,000
New Mexico	709,304	633,786	970,000
New York	20,061,049	25,690,156	23,410,000
North Carolina	30,078,564	28,019,839	35,830,000
Ohio	73,543,190	111,877,124	73,797,000
Oregon	76,122	126,862	182,000
Pennsylvania	28,196,821	45,821,531	44,905,000
Rhode Island	461,497	372,967	414,000
South Carolina	15,065,606	11,767,099	15,013,000
Tennessee	52,089,926	62,764,429	75,204,000
Texas	16,500,702	29,065,172	76,490,000
Utah	90,482	163,342	285,000
Vermont	1,525,411	2,014,271	2,204,000
Virginia	38,319,999	29,119,761	37,680,000
Washington	4,712	39,183	74,000
West Virginia	....	14,090,609	12,516,000
Wisconsin	7,517,300	34,230,579	25,775,000
Total	838,792,742	1,754,591,676	1,456,161,000

In twenty years the production of maize was doubled. The apparent decline in 1887 was due to an unfavorable season. The crop of 1888 was estimated at 1,987,790,000 bushels grown on 75,672,763 acres. The distribution is now more general than that of wheat; it is a crop grown in every State and Territory, though not equally distributed, the higher elevations and poorer soils having a thin distribution. The great corn belt of the country is traversed by the Ohio and Missouri rivers and their tributaries where alluvial soils abound, between five hundred and nine hundred feet of elevation. Here are seven States, from Ohio to Nebraska, which produce

from six-tenths to two-thirds of each annual crop of the United States; and from this region is shipped all the corn that enters the general commerce of the country.

No. 3.—*Oats distribution in the United States. Crops of* 1859, 1879 *and* 1887.

States.	1859.	1879.	1887.
	Bushels.	*Bushels.*	*Bushels.*
Alabama	682,179	3,039,639	4,643,000
Arizona	....	564	....
Arkansas	475,268	2,219,822	4,710,000
California	1,043,006	1,341,271	2,196,000
Colorado	....	640,900	1,569,000
Connectitut	1,522,218	1,009,706	1,088,000
Dakota	2,540	2,217,132	37,266,000
Delaware	1,046,910	378,508	458,000
District of Columbia	29,548	7,440	....
Florida	46,899	468,112	761,000
Georgia	1,231,817	5,548,743	7,044,000
Idaho	....	462,236	1,095,000
Illinois	15,220,029	63,189,200	108,866,000
Indiana	5,317,831	15,599,518	27,943,000
Iowa	5,887,645	50,610,591	74,382,000
Kansas	88,325	8,180,385	40,041,000
Kentucky	4,617,029	4,580,738	8,847,000
Louisiana	89,377	229,840	498,000
Maine	2,988,939	2,265,575	2,684,000
Maryland	3,959,298	1,794,872	2,438,000
Massachusetts	1,180,075	645,159	703,000
Michigan	4,036,980	18,190,793	22,644,000
Minnesota	2,176,002	23,382,158	40,636,000
Mississippi	221,235	1,959,620	4,410,000
Missouri	3,680,870	20,670,958	39,793,000
Montana	....	900,915	1,866,000
Nebraska	74,502	6,555,875	25,365,000
Nevada	1,082	186,860	196,000
New Hampshire	1,329,233	1,017,620	965,000
New Jersey	4,539,132	3,710,573	3,221,000
New Mexico	7,246	156,527	362,000
New York	35,175,134	37,575,506	33,208,000
North Carolina	2,781,860	3,838,068	8,504,000
Ohio	15,409,234	28,664,505	30,098,000
Oregon	885,673	4,385,650	5,547,000
Pennsylvania	27,387,147	33,841,439	33,921,000
Rhode Island	244,453	159,339	165,000
South Carolina	936,974	2,715,505	4,607,000
Tennessee	2,267,814	4,722,190	9,225,000
Texas	985,889	4,893,359	12,193,000
Utah	63,211	418,082	786,000
Vermont	3,630,267	3,742,282	2,736,000
Virginia	10,186,720	5,333,181	11,095,000
Washington	134,334	1,571,706	3,369,000
West Virginia	....	1,908,505	2,531,000
Wisconsin	11,059,260	32,905,320	34,855,000
Wyoming	....	22,512	88,000
Total	172,643,185	407,858,999	659,618,000

The increase in the area and product of oats has been quite constant. It is not exported, except in very small quantity in the form of oatmeal. The increase in volume, from 1859 to 1887, amounts to 282 per cent. It is a crop used, as is maize, mainly for feeding farm animals, though the use of oatmeal as food has become very general. Like corn, it is mainly consumed in the United States, and depends upon home demand for its current price, which rises or falls in sympathy with the price of maize. It produces best in the higher latitudes. In the South it is liable to blight, and deteriorates from year to year in weight. None of the cereals require so frequent change of seed, as the climate of a large portion of the territory is very trying to this grain. The official distribution of seed of heavy weight and strong vitality has greatly improved and enlarged production.

No. 4.—*Cotton and tobacco distribution in the United States. Crops of* 1859, 1879, *and* 1886.

States.	Cotton.			Tobacco.		
	1859.	1879.	1886.	1859.	1879.	1886.
	Bales.	*Bales.*	*Bales.*	*Pounds.*	*Pounds.*	*Pounds.*
Alabama	989,955	699,654	752,220	232,914	452,426	...
Arizona	...	...	...	...	600	...
Arkansas	367,393	608,256	660,872	989,980	970,220	2,108,000
California	...	...	...	3,150	73,317	...
Connecticut	...	...	...	6,000,133	14,044,652	11,667,000
Dakota	...	...	...	10	1,897	...
Delaware	...	...	...	9,699	1,278	...
District of Columbia	...	...	...	15,200	1,400	...
Florida	65,153	54,997	59,332	828,815	21,182	...
Georgia	701,840	814,441	861,720	919,318	228,590	...
Idaho	...	...	...	...	400	...
Illinois	1,482	...	...	6,885,262	3,935,825	6,158,000
Indiana	...	...	...	7,993,378	8,872,842	14,880,000
Iowa	...	...	...	303,168	420,477	...
Kansas	61	...	...	20,349	191,669	...
Kentucky	...	1,367	...	108,126,840	171,120,784	193,915,000
Louisiana	777,738	508,569	471,974	39,940	55,954	...
Maine	...	...	...	1,583	250	...
Maryland	...	...	...	38,410,965	26,082,147	25,238,000
Massachusetts	...	...	...	3,233,198	5,369,436	4,231,000
Michigan	...	...	...	121,099	83,969	...
Minnesota	...	...	...	38,938	69,922	...
Mississippi	1,202,507	963,111	935,390	159,141	414,663	...
Missouri	41,188	20,318	...	25,086,196	12,015,657	11,959,000
Nebraska	...	...	...	3,636	57,979	...
Nevada	...	...	...	...	1,500	...
New Hampshire	...	...	...	18,581	170,843	...
New Jersey	...	...	...	149,485	172,315	...
New Mexico	19	...	...	7,044	890	...
New York	...	...	...	5,764,582	6,481,431	7,583,000
North Carolina	145,514	389,598	365,762	32,853,250	26,986,213	31,559,000
Ohio	...	...	...	25,092,581	34,735,235	35,333,000
Oregon	...	...	...	405	17,325	...
Pennsylvania	...	...	...	3,181,586	36,943,272	34,951,000
Rhode Island	...	...	...	705	785	...
South Carolina	353,412	522,548	498,367	104,412	45,678	...
Tennessee	296,464	330,621	298,133	43,448,097	29,365,052	31,763,000
Texas	431,463	805,284	1,499,698	97,914	221,283	...
Utah	136	...	...	...	...	...
Vermont	...	...	...	12,245	131,432	...
Virginia	112,727	19,595	13,913	123,968,312	79,988,868	91,189,000
Washington	...	...	...	10	6,930	...
West Virginia	...	...	...	...	2,296,146	2,749,000
Wisconsin	...	...	...	87,340	10,608,423	23,744,000
All other States and Territories (including Missouri for cotton in 1886)	...	...	28,483	...	...	3,510,000
Total	5,387,052	5,755,359	6,445,864	434,209,461	472,661,157	532,537,000

Cotton and tobacco are industrial crops suited only to certain soils and climates. The former is a prominent product in only nine States. A very insignificant portion of the crop is of the sea-island variety, grown upon the shores of the Atlantic or Gulf of Mexico, or on the islands near the coast. The green-seed or upland cotton is grown mainly in the tier of States bordering on these waters. In western Tennessee and the lower altitudes of Arkansas, on the alluvium of the Mississippi or in the valleys of rivers flowing into it from the west, are conditions favoring the extension of cotton-growing northward, thus extending its line of northern limitation at that point.

The consumption of the world, rather than that of this country, rules the extension of the cotton area of the United States. The product, therefore, does not increase at the same ratio as an advance in population. The crop of 1859 was abnormally large. It was much larger than that of previous years. The advance can be better understood by comparing the crops of twenty years prior to 1861 with those of twenty-four years since 1865, when planting was resumed after the civil war. In tons the average would be 1,335 for the earlier period, and 2,256 for the later, or an increase of nearly 70 per cent.

Tobacco production is nearly as much restricted, in geographical distribution, as cotton. It is produced as a commercial product in only sixteen States, and in several of these it is grown to a very limited extent.

Tobacco for manufacturing is practically confined to Maryland, Virginia, North Carolina, Kentucky and Tennessee. Tobacco for cigar-making is distributed irregularly through several Northern States, grown mainly in five counties in Connecticut, three in Massachusetts, three in New York, three in Pennsylvania, with a few in Wisconsin and Ohio. About half of the tobacco crop is exported. The proportion consumed in the United States is increasing.

No. 5.—*Product and export of corn.*

Years.	Production.	Exports.	Exportation.	Years.	Production.	Exports.	Exportation.
	Bushels.	*Bushels.*	*Per cent.*		*Bushels.*	*Bushels.*	*Per cent.*
1849*	592,071,104	7,632,860	1.3	1878	1,388,218,750	87,884,892	6.3
1859*	838,792,742	4,248,991	.5	1879	1,754,591,676	99,572,329	5.7
1869*	760,944,549	2,140,487	.3	1880	1,717,434,543	93,648,147	5.5
1870	1,094,255,000	10,673,553	1.0	1881	1,194,916,000	44,340,683	3.7
1871	991,898,000	35,727,010	3.6	1882	1,617,025,100	41,655,653	2.6
1872	1,092,719,000	40,154,374	3.7	1883	1,551,066,895	46,258,606	3.0
1873	932,274,000	35,985,834	3.9	1884	1,795,528,000	52,876,456	2.9
1874	850,148,500	30,025,036	3.5	1885	1,936,176,000	64,829,617	3.3
1875	1,321,069,000	50,910,532	3.9	1886	1,665,441,000	41,368,584	2.5
1876	1,283,827,500	72,652,611	5.7	1887	1,456,161,000	25,360,869	1.7
1877	1,342,558,000	87,192,110	6.5	1888	1,987,790,000	70,841,673	3.6

* Census.

The average export of 19 years, in the form of grain and meal, was 54,313,609 bushels or 3.8 per cent of the crop. In two of these years it was only a fraction of 1 per cent, in three others less than 2 per cent. It has never exceeded 4 per cent, except in the five years of agricultural scarcity in northern Europe, from 1876 to 1880, inclusive. Of course, the secondary products, pork and beef, are subject to foreign demand. It should not be understood, however, that corn is the principal element in the production of either.

No. 6.—*Average yield and price of corn.*

A diagram was exhibited showing how the price advanced with decline of yield per capita, and *vice versa*. The absorbing requirements of the home demand, in the absence of any considerable foreign trade, control almost entirely the price, which consequently fluctuates from year to year. It was 64.7 cents in 1874, and 42 the following year. The lowest average price is 32.8 cents in 1885.

No. 7.—*Acreage and product of wheat.*

Years.	Acreage.	Product.	Years.	Acreage.	Product.
	Acres.	*Bushels.*		*Acres.*	*Bushels.*
1849	8,000,000	100,485,944	1879	35,430,333	459,483,137
1859	14,500,000	173,104,924	1884	39,475,885	512,765,000
1869	20,000,000	287,745,626			

This diagram represents the progress of wheat-growing from 1849 to 1884, by which the supply in proportion to population was doubled. Since the latter date there has been no advance, and no material change, except as the result of less favorable seasons. The crop of 1888 was a small one, estimated at 416,000,000 bushels.

No. 8.—*Product and export of wheat.*

Years.	Product.	Export.	Years.	Product.	Export.
	Bushels.	*Bushels.*		*Bushels.*	*Bushels.*
1849	100,485,944	6,843,177	1879	459,483,137	180,304,181
1859	173,104,924	15,907,335	1887	456,329,000	119,625,344
1869	287,745,626	52,169,114			

The proportion exported rose from 7 to 40 per cent, the highest rate being a result of temporary European scarcity, which was not expected to occur often, if ever again. During the past eight years, including 1880, in which the exportation was 186,321,514 bushels, the largest aggregate recorded, the proportion exported has averaged only 30 per cent, declining from 40 in 1880 to 26 per cent in 1887.

No. 9.—*Progress of cereal production.*

Products.	1849.	1859.	1869.	1879.	1888.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Corn	592,071,104	838,792,742	760,944,549	1,754,591,676	1,988,000,000
Wheat	100,485,944	173,104,924	287,745,626	459,483,137	416,000,000
Oats	146,584,179	172,643,185	282,107,157	407,858,999	702,000,000
Rye	14,188,813	21,101,380	16,918,795	19,831,595	25,000,000
Barley	5,167,015	15,825,898	29,761,305	43,997,495	58,000,000
Buckwheat	8,956,912	17,571,818	9,821,721	11,817,327	11,000,000

The annual average of production of cereals from 1880 to 1887, inclusive, was 2,703,036,457 bushels, and for the ten years preceding 1,872,993,769 bushels. The aggregate for 1888 is about 3,200,000,000 bushels or 51 bushels per capita. Corn comprises five-eighths of the whole. Wheat and oats include most of the remainder. Less than 3 per cent are included in the crops of barley, rye, and buckwheat.

No. 10.—*Produce per capita of cereals in Europe and the United States.*

Countries.	Years.	Total.	Per head.	Countries.	Years.	Total.	Per head.
		Bushels.	*Bushels.*			*Bushels.*	*Bushels.*
Europe		5,153,195,304	15.8	Ireland	1887	59,998,755	12.3
United States	1887	2,658,000,000	44.3	Belgium	1884	71,966,027	13.0
Switzerland		17,473,296	6.1	Spain		226,173,145	13.6
Greece	1877	10,525,854	6.3	Austria	1886	313,227,568	14.1
Servia		14,303,520	7.7	Germany	1886	801,841,939	17.1
Portugal	1877	34,214,576	7.9	France	1886	741,187,972	19.7
Great Britain	1886	258,039,523	8.1	Roumania	1881	102,850,000	19.9
Italy	1886	235,004,210	8.3	Russia	1883–6	1,581,984,411	20.3
Norway	1875	16,915,643	9.3	Hungary	1886	325,015,422	20.6
Netherlands	1885	37,772,800	9.4	Sweden	1887	106,524,779	22.7
Turkey		110,341,440	11.9	Denmark	1885	87,834,424	44.6

In this statement the product of Europe is compared with the crops of the United States in 1887, a year of drought, when the corn crop was greatly reduced, which makes the average per head of population 44.3 bushels, when an average from almost any series of years would be at least 48 bushels, and for years of large production over 50 bushels.

No. 11.—*Increase of farm animals.*

Years.	Mules.	Horses.	Cattle.	Sheep.	Swine.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*
1850	559,331	4,336,719	17,778,907	21,723,220	30,354,213
1860	1,151,148	6,249,174	25,620,019	22,471,275	33,512,867
1870	1,125,415	7,145,370	23,820,608	28,477,951	25,134,569
1880	1,812,808	10,357,488	*35,925,511	*35,192,074	47,681,700
1889	2,257,574	13,663,294	50,331,042	42,599,079	50,301,592

*Exclusive of stock on "ranches."

The increase of horses has been more than 200 per cent since 1850, and of mules 300 per cent.

The quality of horses has been greatly improved by breeding during this time. The infusion of the blood of thoroughbreds has resulted in superior racing and trotting stock; and the introduction of Percheron, Norman, Cleveland Bay, and other heavy English breeds, has greatly improved the class of heavy roadsters and draft horses.

The increase of cattle has been nearly 200 per cent, with marked improvement in weight and condition at a given age, by which beeves are turned off at least a year earlier, or 3½ years of age, and a limited proportion at 2½ years.

Sheep have doubled in numbers, and quadrupled in product of wool. At least three-fourths of all are Merinos and their grades, producing a dense, heavy fleece, of medium fineness of fiber, great elasticity and strength. The grade wool is longer and by special adaptation of machinery is used as combing wool for worsted fabrics.

The increase of swine has also been very large. They are of many breeds, though Poland China occupies the front place in popular estimation throughout the pork-packing region. They are remarkably healthy and freer from trichinæ than those of populous foreign countries. It is noticeable that in the reported deaths of persons eating pork affected by trichinæ, in Europe, there are no well authenticated cases of such mortality from the consumption of the pork products of the United States.

No. 13.—*Exports of fresh beef.*

Years.	Quantity.	Years.	Quantity.	Years.	Quantity.	Years.	Quantity.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*
1877	49,210,990	1880	84,717,194	1883	81,064,373	1886	99,423,362
1878	54,046,771	1881	106,004,812	1884	120,784,064	1887	83,560,874
1879	54,025,832	1882	69,586,466	1885	115,780,830	1888	93,498,273

Value of beef products.

Articles.	1855.	1865.	1875.	1887.
Cattle	$84,680	$159,254	$1,103,085	$9,172,136
Beef, salted	2,600,547	3,308,730	4,197,956	1,972,246
Beef, fresh				7,228,412
Beef, canned				3,462,982
Total	2,685,227	3,467,984	5,301,041	21,835,776

This diagram shows how beef exportation has jumped into importance during the last decade. The fresh-beef trade was inagurated in 1877. It is based on the improvement of native cattle by short-horn and other English breeds. The trade in live cattle, up to 1875, was based on the long-horn or Texan race, derived from the Mexican and originally from Spain, and was entirely with the West India islands. The average value per head has been about one-fifth of the average of fat cattle shipped to Europe.

No. 12.—*Export of hog products.*

Years.	Bacon and hams.	Lard.	Pork.
	Pounds.	*Pounds.*	*Pounds.*
1861	50,264,267	47,908,911	31,297,400
1862	141,212,786	118,573,307	61,820,400
1863	218,243,609	155,336,596	65,570,300
1864	110,886,446	97,190,765	63,519,400
1865	45,990,712	44,342,295	41,710,200
1866	37,588,930	30,110,451	30,056,738
1867	25,648,226	45,608,031	27,374,877
1868	43,659,064	64,555,462	28,690,133
1869	49,228,165	41,887,545	24,439,832
1870	38,968,256	35,808,530	24,639,831
1871	71,446,854	80,037,297	39,250,750
1872	246,208,143	199,651,660	57,169,518
187[illegible]	395,381,737	230,534,207	64,[illegible]47,461
1874	347,405,[illegible]05	205,527,471	70,482,379
1875	250,286,549	166,869,393	56,152,331
1876	327,730,172	168,405,839	54,195,118
1877	460,057,146	234,741,233	69,671,894
1878	592,814,351	342,667,920	71,889,255
1879	732,249,576	326,658,686	84,401,676
1880	759,773,109	374,979,286	95,949,780
1881	746,944,545	378,142,496	107,928,086
1882	468,026,640	250,367,740	80,447,466
1883	340,258,670	224,718,474	62,116,302
1884	389,499,368	265,094,719	*60,363,313
1885	400,127,119	283,216,339	*71,649,365
1886	419,788,796	293,728,019	*87,196,966
188[illegible]	419,922,955	321,533,746	*85,869,367
1888	375,439,68[illegible]	297,[illegible]40,007	*58,836,966
Total	8,405,051,279	5,32[illegible],936,425	1,676,837,1[illegible]4

*Not including fresh pork.

The average exportation of swine products since 1860 has been about 15 per cent of the production, or 2,800,000 hogs, or 560,000,000 pounds of cured product. The number slaughtered during the past year by pork packers and farmers is estimated at 29,000,000 animals. The number slaughtered in the packing establishments was about 17,000,000. The weight of those killed by farmers is less than the packers' average.

No. 14.—*Product and export of cotton,* 1841 *to* 1887.

Years.	Production.	Exports.	Years.	Production.	Exports.
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*
1841	759,903,750	584,717,017	1865	1,041,962,263	650,572,829
1842	1,077,391,350	792,297,106	1866	969,175,303	661,473,588
1843	948,860,550	663,633,455	1867	1,173,431,114	784,763,633
1844	1,118,097,900	872,905,996	1868	1,129,811,645	644,327,921
1845	976,741,650	547,558,055	1869	1,451,401,357	958,558,523
1846	837,215,550	527,219,958	1870	2,020,693,736	1,462,928,024
1847	1,090,850,850	814,274,431	1871	1,384,084,494	933,537,413
1848	1,263,868,200	1,026,602,269	1872	1,833,188,931	1,200,063,530
1849	977,267,700	635,381,604	1873	1,940,648,352	1,358,602,303
1850	1,086,865,650	927,237,089	1874	1,783,644,0[illegible]2	1,260,418,903
1851	1,421,413,340	1,093,230,639	1875	2,157,958,142	1,491,405,334
1852	1,542,325,720	1,111,570,370	1876	2,095,901,297	1,445,369,130
1853	1,396,112,420	987,833,106	1877	2,260,285,666	1,607,533,511
1854	1,363,537,635	1,008,424,601	1878	2,404,410,373	1,628,372,833
1855	1,658,631,975	1,351,431,701	1879	2,771,797,156	1,822,061,114
1856	1,467,129,120	1,048,282,475	1880	3,199,822,682	2,190,928,772
1857	1,554,701,760	1,118,624,012	1881	2,588,236,636	1,739,975,961
1858	1,949,306,728	1,386,468,562	1882	3,405,070,410	2,288,075,062
1859	2,274,372,309	1,767,686,338	1883	2,757,544,422	1,862,572,530
1860	1,934,545,603	307,516,099	1884	2,742,966,011	1,891,659,472
			1885	3,182,350,531	2,058,037,444
Total	26,699,139,760	18,572,894,883	1886	3,157,378,443	2,169,457,330
			1887	3,406,068,167	2,264,120,826
			Total	50,857,831,163	34,374,815,986

A larger proportion of the entire production of cotton is exported than the surplus of any other American product. In 1850 the exports were 85 per cent of the product; in 1885 less than 65 per cent. While production is increasing, the proportion of domestic consumption is constantly increasing. The tendency is to

rapid extension of manufacture, both in the North and in the South, until consumption shall exceed exportation.

No. 15.—*Increase of values of farm products.*

Products.	1859.	1887.
Corn	$360,680,878	$646,106,770
Wheat	124,635,545	310,612,960
Meats	300,000,000	750,000,000
Hay	152,671,168	410,000,000
Dairy products	152,350,000	393,000,000
Cotton	211,516,625	280,000,000
Poultry products	75,000,000	190,000,000
Miscellaneous	298,870,756	891,699,790
Total	1,675,724,972	3,871,419,520

The increase of population in twenty-eight years, from 1859 to 1887, was about 95 per cent. The value of farm products was considerably more than doubled. The statement above does not include all minor products, and, on the other hand, a part of the corn is duplicated in meats; yet the aggregate represents nearly the net result of the calculation.

The prices of 1859 and 1887 differ very little as to most of these products. Those of meat and potatoes are higher at the later date, but those of the cereals differ only slightly. Corn, for instance, is estimated at 43 cents in 1859, and at 44.4 cents in 1887; wheat 72 cents in 1859, and 68.1 cents in 1887; oats 25 in 1859, and 30.4 in 1887. The farm price of cotton was nearly the same at the two dates.

No. 16.—*Value of products of American agriculture and proportion exported, 1886–'87.*

Products.	Production (farm value).	Exportation (farm value).	Per cent.
Breadstuffs:			
Corn	$610,311,000	$11,790,046	1.9
Wheat	314,226,020	87,668,833	27.9
Oats	186,137,930	343,659	.2
Barley	31,840,510	691,809	2.2
Rye	13,181,330	197,687	1.5
Buckwheat	6,465,120	....	.....
Rice	5,000,000	26,284	.5
Total	1,167,161,910	100,718,318	8.6
Meats	748,000,000	62,522,185	8.4
Poultry products	186,000,000	71,176	.....
Hides, hair, etc	93,000,000	825,902	.9
Dairy products:			
Butter	192,000,000	1,487,773	.8
Cheese	32,000,000	6,455,438	20.2
Milk	156,000,000	181,279	.1
Total	380,000,000	8,124,490	2.1
Textile fibers:			
Cotton	257,295,327	177,895,501	69.1
Wool	77,000,000	70,202	.1
Hemp, flax, etc	9,000,000	....	.....
Total	343,295,327	177,965,703	51.8
Vegetables:			
Irish potatoes	78,441,940	236,694	.3
Sweet potatoes	20,000,000	....	.....
Pease and beans	13,800,000	450,291	3.3
Market gardens	68,000,000	256,518	.4
Fruits	175,000,000	1,601,979	.9
Hay	353,437,699	130,804	.....
Tobacco	39,082,118	20,510,386	52.5
Hops	3,500,000	46,725	1.3
Sugar and sirup, including honey	33,500,000	....	.....
Clover and grass seed	15,000,000	638,329	4.3
Wines	10,000,000	129,103	1.3
Grand total	3,727,218,994	374,230,603	10.1

This diagram presents in graphic detail the values of the various products of agriculture and the proportions of each that are exported, on the basis of the production of 1886, and the exportation of the fiscal year ended June 30, 1887. It shows that American agricultural exports are practically confined to the two industrial products—cotton and tobacco, and to meats, cereals, and cheese. One might use the word "wheat" instead of "cereals," as less than 4 per cent of maize is exported, and very little of barley or rye, and no buckwheat. In fact, more than ten bushels of barley is imported for every bushel exported. Our exports, then, are cotton and tobacco and bread and meats, and the farm value of all exports is about one-tenth of the total value of all production.

No. 17.—*Average wages of farm labor.*

Years.	California.	Western States.	Southern States.	Middle States.	Eastern States.	Average United States.
1866	$35.75	$28.91	$16.00	$30.07	$33.30	$21.71
1869	46.38	27.01	17.21	28.02	32.08	20.98
1875	44.50	23.60	16.22	26.02	28.96	19.87
1879	41.00	20.38	13.31	19.69	20.21	16.42
1882	38.25	23.63	15.30	22.24	26.61	18.94
1885	38.75	22.26	14.27	23.19	25.30	17.97
1888	38.08	22.22	14.54	23.11	26.03	18.24

The rates of wages of agricultural labor, as averaged from returns to the Division of Statistics of the Department of Agriculture, are on the basis of monthly salaries for the year, without board—the laborer furnishing his own board. It was higher in 1866 and 1869, because of currency inflation, and lower than the average in 1879, the time of culmination of the monetary depression which began to be operative in the latter part of 1873. After the return to specie payments, in 1879, prices of products, and soon the rate of wages, rose to their natural level.

The general average for 1888 is $18.24, equal to 218.88, or about $220 per annum in round numbers. This includes the labor of freedmen in the South, which reduces the average below that of white labor in the country, the average for the Southern States being $14.54 against $22.22 for the Western States. That of the Middle and Eastern States is still higher. The average for white labor of Northern States might be fairly stated at $275 per annnm.

No. 18.—*Foreign trade of the United States*, 1887-'88.

Exports of domestic merchandise.		Imports of merchandise.	
Kind.	Value.	Kind.	Value.
Nonagricultural	$184,896,075	Non-agricultural	$405,455,029
Agricultural:		Agricultural:	
Animal products	109,882,948	Sugar and molasses	79,736,301
Bread and breadstuffs	127,191,687	Tea, coffee, and cocoa	76,120,088
Cotton and cotton-seed oil.	224,942,499	Animal products	55,757,254
Miscellaneous	36,948,895	Miscellaneous	106,888,442
Total agricultural	498,966,029	Total agricultural	318,502,085
Total exports	683,862,104	Total imports	723,957,114

The balance of trade was against the United States from 1845 to 1875, inclusive, with only four exceptional years, and the net excess of imports of merchandise amounted to $1,532,943,439, an annual average of $49,449,788.

The prosperity of the country at length caused a turn of the tide, and from 1876 to 1887, inclusive, there was an unbroken series of favorable balances, making an aggregate excess of exports of $1,612,659,755, and an annual average of $134,388,313. In 1888 there was an excess of imports of $28,002,607.

A statement by decades shows the rapid development of external commerce:

Years.	Exports.	Imports.	Years.	Exports.	Imports.
1850	$144,375,726	$173,509,526	1880	$835,638,658	$667,954,746
1860	333,576,057	353,616,119	1888	695,954,507	723,957,114
1870	392,771,768	435,958,408			

No. 19.—*Dietaries of different peoples.*

		Nutrients.				Potential energy in nutrients.
		Protein.	Fats.	Carbohydrates.	Total.	
	European and Japanese dietaries.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
1	Sewing girl, London, wages 93 cts. (38.9.*d*) per week	53	33	316	402	1,820
2	Factory girl, Leipsic, Germany, wages $1.21 per week	52	53	301	406	1,940
3	Weaver, England, time of scarcity	60	28	398	486	2,138
4	Laborers, Lombardy, Italy, diet mostly vegetables	82	40	362	484	2,192
5	Trappist monk in cloister, very little exercise, vegetable diet	68	11	469	548	2,304
6	Students, Japan	97	16	438	551	2,343
7	University professor, Munich, Germany, very little exercise	100	100	240	440	2,324
8	Lawyer, Munich	80	125	222	427	2,401
9	Physicians, Munich	131	95	327	553	2,762
10	Painter, Leipsic, Germany	87	69	366	522	2,500
11	Cabinetmaker, Leipsic, Germany	77	57	466	600	2,757
12	"Fully-fed" tailors, England	131	39	525	695	3,053
13	"Well-paid" mechanic, Munich, Germany	151	54	479	684	3,085
14	Carpenter, Munich, Germany	131	68	494	693	3,194
15	"Hard-worked" weaver, England	151	43	622	816	3,569
16	Blacksmith, England	176	71	667	914	4.117
17	Miners, at very severe work, Germany	133	113	634	880	4,195
18	Brickmakers (Italians at contract work), Munich	167	117	675	959	4,541
19	Brewery laborer, Munich, very severe work, exceptional diet	223	113	909	1,245	5,692
20	German soldiers, peace footing	114	39	480	633	2,798
21	German soldiers, war footing	134	58	489	681	3,093
22	German soldiers, Franco-German war, extraordinary ration	157	285	331	773	4,652
	American dietaries. Dietary standards.					
23	French Canadians, working people in Canada	109	109	527	745	3,622
24	French Canadians, factory operatives, mechanics, etc., in Massachusetts	118	204	549	871	4,632
25	Other factory operatives, mechanics, etc., Massachusetts	127	186	531	844	4,423
26	Glass-blowers, East Cambridge, Massachusetts	95	132	481	708	3,590
27	Factory operatives, dressmakers, clerks, etc., boarding house	114	150	522	786	4,002
28*a*	Well-to-do private family, Connecticut. Food purchased	129	183	467	779	4,146
28*b*	Well-to-do private family, Connecticut. Food eaten	128	177	466	771	4,082
29*a*	College students from Northern and Eastern States; boarding club, two dietaries of the same club. I. Food purchased	161	204	680	1,045	5,345
29*b*	College students from Northern and Eastern States; boarding club, two dietaries of the same club. I. Food eaten	138	184	622	944	4,827
30*a*	College students from Northern and Eastern States; boarding club, two dietaries of the same club. II. Food purchased	115	163	460	738	3,874
30*b*	College students from Northern and Eastern States; boarding club, two dietaries of the same club. II. Food eaten	104	136	421	661	3,417
31	College foot-ball team, food eaten	181	292	557	1,030	5,742
32	Machinist, Boston, Massachusetts	182	254	617	1,053	5,638
33	Brickmakers, Middletown, Connecticut	222	263	758	,243	6,464
34	Teamsters, marble-workers, etc., Boston, Massachusetts *	254	363	826	1,443	7,804
35	Brickmakers, Cambridge, Massachusetts	180	365	1,150	1,695	8,848
	Standards for dietaries.					
36	Subsistance diet. Playfair	57	14	341	412	1,762
37	Diet "in quietude" for adults without exercise. Playfair	71	28	341	440	1,949
38	Laboring man, with moderate work, German. Voit	118	56	500	674	3,555
39	Laboring man, with hard work, German. Voit	145	100	447	692	3,358
40	Laboring man, with moderate work, American. Atwater	125	125	450	700	3,521
41	Laboring man, with hard work, American. Atwater	150	150	500	800	4,060

*Boarding house, board $5 per week.

This table of nutritive equivalents of a large number of American and European dietaries was prepared under the direction of Prof. W. O. Atwater, director of the division of experiment stations in the Department of Agriculture.

CHAPTER XXXIV.

A REPORT ON THE HISTORY AND PRESENT CONDITION OF AGRICULTURAL SCIENCE AND EDUCATION IN THE UNITED STATES.

By A. C. TRUE.

The movement for the promotion of agricultural science and education in the United States has reached that period when it seems about to reap the fruits of the labors of the pioneers and to enter into a vast heritage of popular favor and golden opportunities for usefulness. The centennial celebrations of the great events in the early history of this nation have awakened in the minds of our people a deep consciousness of the enormous possibilities that are involved in the material resources of the country, but they have also brought into bold relief before the public eye the fact that our resources are not limitless, and that the ever-increasing rapidity of our growth in population will ere long bring us face to face with that problem of how to find food for the hungry which has proved so troublesome to older peoples and civilizations. The general diffusion of elementary education, the overcrowding of those occupations for which the ordinary training of the schools suffices, the abolishment of the apprentice system by which the youths were prepared to become skilled laborers, the complications introduced into almost every pursuit by the use of machinery and the application of scientific principles, the employment of women in numerous industries once open only to men, have pressed home the fact that every year it is more certain that the possession of the ordinary school education will not insure a livelihood to the willing and industrious worker; that when the youth has once chosen his occupation he must have an opportunity to prepare himself for it by special technical training; that the man who has neither the general nor the technical training of the schools, while he may escape the poorhouse by unremitting toil as a hewer of wood and drawer of water, cannot hope to have those comfortable surroundings and those opportunities for social advancement which every right-minded American citizen claims for himself and for his children. And while these ideas have become more or less clearly aroused in the minds of average citizens, statesmen and moralists have become alarmed lest the mass of native and foreign ignorance which slavery and immigration have entailed upon the Republic prove too heavy an incubus for its free institutions, and have, therefore, given increasing attention to schemes for popular education in the sciences and arts. Moreover, the astonishing results which in recent years have come from the application of scientific principles to the useful arts have shown to scientists their privilege and obligation to make their investigations contribute to the welfare of mankind; hence they are more ready than ever before to bend their energies to the

working out of the practical problems which confront the business man and the farmer, and, having this disposition, they find themselves every year with more to offer for the satisfaction of the demand for knowledge that can be immediately utilized. It should also not be forgotten that the discussion of economical and ethical questions involved in the relations of capital and labor has more clearly revealed the truth that in the body politic we are members one of another, and that "if one member suffers all the members suffer with it," and that, while there must be such freedom of activity and such friendly rivalry of enterprise as shall stimulate the highest and best capabilities of the individual, there must also be that yielding of personal desires and that coöperation in labors for the common welfare which shall enable the great community we call our country to secure for all its members a high average of intelligence, wealth, and happiness. The general facts thus briefly stated obviously have a special application to the movement for the promotion of agriculture. Until very recently farming has been generally regarded as an occupation that could be carried on with unskilled labor, and even now the mass of men engaged in this pursuit are unable to see how any technical knowledge of practical value can be given to their children in the schools, and are inclined to look upon scientific experiments in agriculture as vain attempts to change the methods of a calling which has remained substantially the same in its operations since the beginning. But the leaven of modern restlessness and desire for improvement is rapidly working its way into the masses of our agricultural population and making a wondrous change in the attitude of the average farmer toward agricultural schools, experiment stations, farmers' institutes, agricultural societies, newspapers, and all other means for his improvement as a skilled workman and a good citizen. At this juncture it would be an interesting and helpful thing to trace the growth of this movement in the United States from its inception, for this historical survey would add another proof that the times are ripe for the general diffusion of scientific and technical knowledge among our farmers. Unfortunately, the materials for a thorough treatment of this history have never been collated, but it nevertheless seems best to attempt a rough sketch of the movement as a preface to a report on the present condition of public institutions already established here for the promotion of agricultural science and education.

As far as is now known, the first society for promoting agriculture in the United States was established at Philadelphia, then the seat of the General Government, March 1, 1785, by men who were for the most part engaged in pursuits having no immediate connection with agriculture. On the 4th of July, 1785, Gen. Washington was elected an honorary member of this society and ever afterwards showed a deep interest in its proceedings. Benjamin Franklin's name is also found on the list of its honorary members. In the same year a similar society was formed in South Carolina, which had among its objects the establishment of an experimental farm. The New York Agricultural Society was organized February 26, 1791, and about the same time a society was formed at Kennebec, Massachusetts (now Maine). The Massachusetts Society for Promoting Agriculture was incorporated March 7, 1792, and in 1794 the Western Society of Middlesex Husbandmen was formed in Massachusetts, though not incorporated until 1803. On the 21st of January, 1794, a committee was appointed by the Philadelphia society "to prepare outlines of a plan for establishing a State society for the promotion of agriculture; connecting with it the education of youth in the knowledge of that most important art, while they are acquiring other useful knowledge suitable for the agricultural citizens of the State." The committee made a report, in which several alternatives for promoting agricultural education were presented to the legislature: "Whether by endowing professorships, to be annexed to the University of Pennsylvania and the College of Carlisle, and other seminaries of learning, for the purpose of teaching the chemical, philosophical, and elementary parts of the theory of agriculture; or by adding to

the funds of the society, increase their ability to propagate a knowledge of the subject, and stimulate, by premiums and other incentives, the exertions of the agricultural citizens; or whether by a combination of these means the welfare of the State may be more effectually promoted."

It was also a part of the plan to make the common-school system of the State contributory to the technical education of the farmer. "The country schoolmasters may be secretaries of the county societies, and the schoolhouses the places of meeting and repositories of their transactions, models, etc. The legislature may enjoin on these schoolmasters the combination of the subject of agriculture with the other parts of education. This may be easily effected by introducing as school books those on this subject, and thereby making it familiar to their pupils. These will be gaining a knowledge of the business they are destined to follow, while they are taught the elementary parts of their education. Books thus profitable to them in the common affairs of life may be substituted for some of those now used, and they can easily be obtained. Selections from the best writers in husbandry may be made by the society. The essays of our own experimentalists or theorists, and the proceedings of the society, will also afford information."

This report seems to have been the first formal attempt made in the United States to urge the claims of agricultural education and experimentation upon the attention of a law-making body.

Two years later, on the 7th of December, 1796, in his annual message to the second session of the Fourth Congress, Washington shows his interest in the subject by the following recommendation:

"It will not be doubted that, with reference either to individual or national welfare, agriculture is of primary importance. In proportion as nations advance in population and other circumstances of maturity, this truth becomes more apparent, and renders the cultivation of the soil more and more an object of public patronage. Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater propriety? Among the means which have been employed to this end, none have been attended with greater success than the establishment of boards, composed of public characters, charged with collecting and diffusing information, and enabled by premiums and small pecuniary aid to encourage and assist a spirit of discovery and improvement. This species of establishment contributes doubly to the increase of improvements by stimulating to enterprise and experiment, and by drawing to a common center the results everywhere of individual skill and observation, and spreading them thence over the whole nation. Experience accordingly has shown that they are very cheap instruments of immense national importance.

"I have heretofore proposed to the consideration of Congress the expediency of establishing a National University, and also a Military Academy."

Congress soon established the Academy to promote the science and art of war, but paid no attention to the words of the great General in favor of institutions to benefit the sciences and arts of peace.

In 1797 the trustees of the Massachusetts society began the publication of pamphlets, or, as we should now say, bulletins, on agricultural topics, which afterwards were developed into a regularly issued journal. At least two other societies were formed during the last century, the New York Society for the Promotion of Agriculture, Manufactures, and Arts, March 12, 1798, and a voluntary Agricultural Association at Sturbridge, Massachusetts, in 1799.

Near the opening of the new century (in 1801) a suggestion was made to the Massachusetts Society that fairs should be regularly held in May and October on Cambridge Common and bounties given for certain articles. This plan included not only the exhibition of agricultural products, but also stated open markets for their sale. No action was taken by the society regarding this suggestion. In the

same year this society discussed a proposition for the permanent endowment of a professorship of natural history and a botanic garden at Harvard College. The society took a lively interest in this matter, and was enabled to carry out the suggestion in 1804, when William D. Peck was elected to fill the new chair. In the report of the United States Commissioner of Agriculture for 1866, in an article on the history of the Agriculture of the United States, by Ben: Perley Poore, may be found the following statements regarding the first attempts made at the newly established seat of the national government to promote the interests of American agriculture. "In 1804 it was suggested by Dr. Thornton, the first Commissioner of Patents, then residing in Washington, which was literally a 'city in the woods,' that the ready sale of cattle and of domestic products could be promoted by the holding of fairs on market days, as in England, his native land. The idea met with the warm approval of the citizens, and the municipal authorities passed an act establishing semi-annual fairs. An editorial article in the *National Intelligencer* of October 17 spoke of the coming fair as offering advantages to purchasers and to settlers, 'while at the same time it can but prove equally beneficial to the agricultural interests of our country.' The fair was held on Wednesday, Thursday, and Friday, in 'the Mall at the south side of the Tiber, extending from the bridge at the Center Market to the Potomac.'

"'It was a decided success,' and before the next one was held an attempt was made by additional legislation on the part of the city government to increase its usefulness by appropriating $50 towards a fund for premiums. The citizens raised by subscription an equal sum, so that at the fair, which began on the 26th of April, 1805, premiums to the amount of $100 were awarded to the best lamb, sheep, steer, milch cow, yoke of oxen, and horse actually sold. A third fair was held in November, 1805, after which they were discontinued.

"Early in the year 1806, Joel Barlow, esq., then residing at Kalorama, in the vicinity of Washington, published the prospectus of a 'national academy,' in which he enumerated, among the foreign institutions to be copied in forming an American organization, the agricultural societies of England and the veterinary school of France. Meanwhile an institution had been organized by 'members of Congress, officers of the Federal Government, and others, devoted to objects connected with public economy.' Meetings were held at Mr. Hervey's on Pennsylvania avenue every Saturday evening, from 5 until 8 o'clock, and among the subjects considered were: 'Our mechanical economy, or the means of abridging labor by useful inventions, implements, and apparatus; our agricultural economy, or the means of producing the most abundant and most reciprocal crops, under any given circumstances, without doing things by guess; the economy of our forests, or the best management of our latent resources there.'"

In the autumn of 1807, Elkanah Watson, a native of Plymouth, Massachusetts, and a direct descendant of Governor Edward Winslow, who in 1624 had brought to Plymouth, in the ship *Charity*, three heifers and a bull, "the first neat cattle that came to New England," procured the first pair of merino sheep which had been introduced into Berkshire County, and gave notice of an exhibition of his 2 sheep on the public square at Pittsfield. He wrote that "many farmers and even females were attracted to this first novel and humble exhibition." The interest excited by this exhibit led Mr. Watson to undertake a larger enterprise, and on the 1st of August, 1810, an appeal drawn by himself and signed by 26 persons was published, appointing an exhibition of stock at the same place, on the 1st of October. This "cattle show" was quite successful, and before many years the annual exhibit became a permanent and popular institution in Massachusetts. Mr. Watson's report of the exhibition of September, 1811, shows the picturesque elements which were thus early introduced into these rural festivals. There was 'a procession of 69 oxen drawing a plow held by the oldest man in the county; a band of

music; the society bearing appropriate ensigns, each member decorated with a badge of 2 heads of wheat in his hat, and the officers 3 heads secured by a green ribbon." Meanwhile, in 1809, a number of gentlemen interested in agriculture, residing in Maryland, Virginia, and the District of Columbia, had formed the Columbian Agricultural Society, which may properly be considered as the germ of a national organization. This society actively engaged in the work of educating the farmer through the agency of exhibitions.

Various causes seem to have contributed to retard the progress of agricultural education during the next decade. The war with England from 1812 to 1815 undoubtedly turned the attention of our people away from the consideration of measures for the improvement of agriculture. The obstruction to commerce growing out of the wars of Napoleon and the quarrel between England and the United States caused the manufactures of this country to develop with wonderful rapidity. The enterprising youth were drawn in large numbers from the farms to the factories, and the public mind was occupied with schemes for increasing the wealth of the country in this direction. However, in 1817 the Berkshire Agricultural Society of Massachusetts, under the enthusiastic leadership of Elkanah Watson, presented a memorial to Congress, praying for the establishment of a national board of agriculture, in accordance with the original suggestion by President Washington. A bill for this purpose was actually reported in the House of Representatives, but was defeated by an overwhelming vote. Some members opposed the bill because there was in their judgment no warrant in the Constitution for such an institution; others based their opposition on questions of expediency or on the general indifference of the agricultural public. It was also well known that President Madison was not in favor of the measure. The decade closes with the establishment of the New York Horticultural Society, the first horticultural society in the United States, in 1818, and the publication of the first distinctively agricultural periodical in this country, *The American Farmer*, in Baltimore, Maryland, in 1819. This was followed by *The New England Farmer*, first published in 1822.

There were comparatively few events of striking interest to mark the progress of agriculture in the United States during the next 20 years. During this period the boundaries of the Republic were greatly enlarged; the introduction of steam as a motive power was already contributing largely to the movement of population from worn-out lands in the East to fertile districts farther west; the demoralization of enterprise resulting from the employment of slaves was beginning to be felt in the South; questions relating to the extension of slavery, to methods of transportation, to the establishment of new States and Territories, to public systems of free elementary education, were absorbing public attention. There was little heed paid to the claims of scientific agriculture or thought about the necessity for technical education. About 1825, however, there was considerable popular interest in the scheme for the culture and manufacture of silk in the United States. Congress responded to the demand for information by ordering the publication of a well-digested manual prepared by Richard Rust, Secretary of the Treasury, containing the best practical information that could be collected on the growth and manufacture of silk. In 1828 an edition of a Treatise on the Rearing of Silkworms, by Count Von Haggie, of Munich, was printed as a congressional document, and several valuable reports on silk-culture were made and published, until the bursting of the "*Morus multicaulis* bubble" checked this branch of agricultural industry.

Ten years later public attention was rudely awakened to the necessity of doing something to prevent the rapid exhaustion of the soil, which was becoming a matter of serious concern in all the States along the Atlantic seaboard. The failure of the crops in 1837–38 turned the balance of trade heavily against us and caused the importation of millions of dollars' worth of breadstuffs. It was under these circumstances that Judge Buell, of the State of New York, came forward to advocate

the establishment of agricultural colleges, and a movement in the interest of agricultural education was begun in his State. From this time may also be dated the beginning of active interest in agriculture on the part of the National Government. At the prompting of Hon. Henry L. Ellsworth, Commissioner of Patents, Congress, in 1839, made an appropriation of $1,000 for the "collection of agricultural statistics, investigations for promoting agricultural and rural economy, and the procurement of cuttings and seeds for gratuitous distribution among the farmers." In the two succeeding years Congress failed to make any further appropriation, but the Commissioner of Patents did not flag in his efforts to secure recognition of the claims of the farmers by the national legislature, and in 1842 the appropriation for agriculture was renewed and has ever since been regularly made. The first attempt to organize a national agricultural society was made at Washington in 1841 by a convention of persons desiring "to elevate the character and standing of the cultivation of the American soil." It was hoped that the fund left by Hugh Smithson might be made available for the maintenance of such an organization, but the establishment of the Smithsonian Institution frustrated these expectations, and "the national society remained dormant until 1852."

At the annual meeting of the New York State Agricultural Society in January, 1844, a committee of seven, consisting of Hon. John Greig, Governor Seward, Lieutenant Governor Dickinson, Col. John A. King, James S. Wadsworth, Judge Savage, and Henry O'Reilly, was appointed to promote "the introduction of agricultural books and studies in the schools and libraries throughout the State, and also for the purpose of selecting such prize essays from among the transactions of the society as may be most appropriately published in volumes of suitable size for the 'family and school district libraries,'" and the society further resolved "that this society regards the establishment of an Agricultural Institute and Pattern Farm in this State, where shall be taught thoroughly and alike the science, the practice, and the profits of good husbandry, as an object of great importance to the productive agriculture of New York."

This committee entered into correspondence with school superintendents and influential friends of agriculture in several States and presented an elaborate report the following year, in which are quoted the resolutions passed by the State convention of common-school superintendents held in June, 1844. The chairman of the committee which submitted these resolutions was Prof. Potter, of Union College, and the committee stated that in their opinion "the time has arrived when the elements and scientific principles of agriculture should be taught in all our schools, especially to the older class of pupils."

Sufficient interest was awakened in this and other plans for the promotion of agriculture to make it seem to the United States Commissioner of Patents worth while to send a special agent to Europe to investigate the movements there in the same direction. In the report of this agent, published in 1847, is contained an account of the European agricultural schools.

In 1846 John P. Norton was appointed professor of agricultural chemistry and vegetable and animal physiology at Yale College, New Haven, Conn. Prof. Norton began his lectures in 1847, and during the next five years also wrote extensively for agricultural journals, edited an American edition of Stevens on the Farm, and published a work of his own on the Elements of Agriculture. In 1848 Governor Fish, of New York, in his annual message to the legislature of the State, recommended the establishment of a State agricultural school. In an address before the Norfolk Agricultural Society, delivered in 1849, Hon. Marshall P. Wilder urged the advisability of establishing an agricultural college in Massachusetts. The idea speedily took hold of the friends of agriculture in that State to such an extent that in 1850 the State Senate of Massachusetts passed a bill to found such an institution, but it was defeated in the House. As a compromise measure

a board of commissioners was appointed to investigate the matter. The commissioners sent Prof. Hitchcock to Europe to visit the agricultural schools already in operation there, and his report was transmitted to the legislature in the following year. The only immediate outcome of this movement was the establishment of the Massachusetts board of agriculture in 1852.

The United States Commissioner of Patents had meanwhile begun to urge upon Congress the desirability of giving national aid to agricultural education. In his report for the year 1850 he deplores the lack of qualified men to fill professorships in agricultural colleges, and says that "if a young farmer engaged in stock-growing wishes to study the digestive organs, the muscles, nerves, or blood vessels of the horse, cow, sheep, or hog, there is not a museum in all America where this can be done." And in the two succeeding years the same official published in his reports letters from prominent agriculturists urging the establishment of a national school for the training of teachers for agricultural and other industrial schools.

In 1853, John Delafield and others, residents of Ovid, New York, obtained a charter for the New York State Agricultural College to be located in that place. "About seven hundred acres of land were purchased and buildings erected sufficient to accommodate one hundred and fifty students." It was not until 1860 that the institution was opened, and its operations lasted only two terms, for when the civil war broke out its president obeyed the summons to arms, and the college was closed.

The constitution of the State of Michigan, adopted in 1850, requires that "the legislature shall provide for the establishment of an agricultural school for agriculture and the natural sciences connected therewith." In obedience to this provision, an act for the establishment of a State agricultural college was adopted by the legislature of Michigan in 1855, and approved February 12 of that year, and the organization of the institution given into the charge of the State board of education. A farm, then in the woods, of 676 acres, lying 3½ miles east of the city of Lansing, was purchased and buildings erected, and on the thirtieth day of May, 1857, the college was formally opened for the reception of students. The institution began with 61 students and 5 professors. To Michigan, therefore, belongs the honor of having been the first of the States to put in actual operation an educational institution for the direct promotion of technical training in agriculture. Meanwhile, in 1856, Mr. Wilder, of Massachusetts, had succeeded in obtaining from the legislature of his State a charter of "The Trustees of the Massachusetts School of Agriculture," and from Congress a charter of the United States Agricultural Society, which had been formed in 1852. It is, perhaps, worth while to notice that this latter was opposed in the Senate by Jefferson Davis on the ground that "Congress had no power to create corporations."

The activity of the friends of scientific and agricultural education now began to extend itself beyond the limits of State legislation, and numerous petitions were presented to Congress asking for national aid for industrial colleges. On the 14th of December, 1857, Justin S. Morrill, then a member of the House of Representatives and now a venerable Senator from the State of Vermont, introduced a bill into the lower House authorizing the establishment of an agricultural and mechanical college in each State and granting for the maintenance of such institutions 20,000 acres of the public land for each member of Congress. This bill was referred to the Committee on the Public Lands, who brought in an adverse report April 15, 1858. Nevertheless, in the following session of Congress the bill passed both Houses, but was vetoed by President Buchanan. The storm of civil war came speedily on, and for a little time the men of the North thought only of the necessity of saving the Union. To the superficial observer it may seem even now that the tide of battle rolled so steadily against the Federal forces during the first year of that awful struggle that it would have taken but a little thing to destroy the Republic. But there can hardly be better evidence of the dogged resolution and the conscious-

ness of real strength which lay behind the wavering advance lines of the hosts of the Union than is presented by three of the most important acts of the session of Congress of 1862; for it was this Congress that freed the slaves in the District of Columbia, passed the homestead act which gave, and still gives, 160 acres of the public domain to every man who would take the trouble to pick out his farm and permanently settle on it, and also passed the amended Morrill act, which bestowed 30,000 acres of land for each member of Congress upon the several States for the establishment of colleges "to teach such branches of learning as are related to agriculture and the mechanic arts in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." In December, 1861, Mr. Morrill introduced his amended bill in the House of Representatives, and May 2, 1862, Benjamin Wade, of Ohio, introduced a similar bill in the Senate. On the 29th of May the bill was reported adversely in the House by the Committee on the Public Lands, but was passed by the Senate June 10, and nine days later by the House. President Lincoln made the bill a law by affixing his signature July 2, 1862, the very day when McClellan's army began its retreat from the Peninsula after the bloody battle of Malvern Hill. Amid the national gloom which succeeded the failure of the Union's greatest army to take the capitol of the Confederacy, few paid any attention to the gift of over 17,000,000 of acres to promote the art and industries of peace. It is a significant fact that in the amended bill it was provided that every institution receiving the benefits of the land grant should provide for the military training of its students. It then seemed probable that the farmers of the country once more, as in the early colonial days, must be prepared to take the rifle and the plow into the field together, no longer to defend themselves against the attacks of hostile Indians, but rather against the more cruel onslaught of misguided brethren. Thousands of students are to-day drilling in the colleges established by this act; but one flag floats over them all, and, in the bonds of a union more firmly united with each passing year, the martial dreams of these ardent youth are all directed against the imaginary incursions of some foreign foe.

The total number of acres granted by this act was 17,430,000, and the fund arising from their sale is about $8,000,000. This has been increased by gifts from the States and from benevolent individuals of grounds, buildings, and apparatus to about an equal amount. The total value of grounds, buildings, apparatus, and productive funds of these colleges is now not far from $20,000,000. The last published report of the U. S. Bureau of Education, for 1886–'87, contains the following general statements concerning the land-grant institutions:

"The number of institutions in the United States sharing in the benefit of the land grant of 1862 is forty-eight.

"In thirteen States the grant was made over to universities or colleges already existing, and has served to establish or augment the funds of courses, departments, or schools of applied science in the same. In the twenty-five remaining States the fund has served as the chief source of endowment for new institutions or as the nucleus around which have collected additional funds, in several cases far exceeding the amount derived from the national grant. In six States the grant has been divided. In Georgia it has been applied to the endowment of six colleges of agriculture affiliated to the State University; in Massachusetts separate colleges, one of agriculture, the other of the mechanic arts, have been the recipients; in Missouri a portion of the grant has been applied to the endowment of 'an agricultural and mechanical college' and the rest to the endowment of a 'school of mines and metallurgy,' both under the auspices of the University of Missouri; in Mississippi, South Carolina, and Virginia the fund has been divided between institutions for white and colored students respectively.

"Certain of the schools have developed particularly in the direction of the me-

chanical arts; others are agricultural colleges, pure and simple; a few combine both departments, with large provision for theoretic instruction; while some differ in no essential from the ordinary classical college."

The total number of instructors in these institutions is about 700 and the total number of students about 10,000.

By an act of Congress, approved May 15, 1862, a Department of Agriculture was established "to acquire and diffuse among the people of the United States useful information on the subjects connected with agriculture in the most general and comprehensive sense of that word, and to procure, propagate, and distribute among the people new and valuable seeds and plants." Isaac Newton was appointed by President Lincoln as the first Commissioner of Agriculture.

In 1872, at the suggestion of the United States Commissioner of Agriculture, a convention of delegates from the agricultural colleges already established was held at Washington. At this meeting a petition was presented to the Commissioner asking him to open an office of correspondence between the colleges. At the next convention, in January, 1882, the same subject was much debated, and the Department of Agriculture was urged to prepare a digest of the agricultural experimentation at the best stations of foreign countries, and also to secure coöperation among those persons who were engaged in systematic agricultural experimentation in this country. The convention of the following year, in which delegates from the agricultural colleges of sixteen different States participated, passed a resolution indorsing the bill which had been introduced in Congress by C. C. Carpenter, of Iowa, for the establishment of agricultural experiment stations in connection with the agricultural colleges.

After the fund which had been established by the sale of the land-scrip donated to Connecticut under the act of Congress of July 2, 1862, had been given to the Sheffield Scientific School of Yale College in 1863, a professor of agriculture was added to the working force of that institution. Samuel W. Johnson, M. A., the successor of Prof. Norton as professor of theoretical and agricultural chemistry, and William H. Brewer, Ph. D., the professor of agriculture, have for many years taken an active interest in all work for the promotion of agricultural science in Connecticut and elsewhere in the United States. Under their direction experimental work for the benefit of agriculture was carried on to a limited extent at New Haven more than twenty years ago, and it is doubtless safe to say that "through the influence of the professors and pupils trained in this school, more than to any other single cause, is due the recognition of the importance of the establishment of agricultural experiment stations, first in Connecticut, and subsequently throughout the whole country."

In 1870 the President and Fellows of Harvard College began to organize the school of agriculture and horticulture which had been provided for in the will of Mr. Benjamin Bussey, of Roxbury, Mass. This interesting document was signed July 30, 1835, and was proved soon after the death of the testator in 1842. It bequeathed half of the income of about $300,000 and 200 acres of land in Roxbury to the President and Fellows of Harvard College, on condition that they establish on the farm "a course of instruction in practical agriculture, in useful and ornamental gardening, in botany, and in such other branches of natural science as may tend to promote a knowledge of practical agriculture and the various arts subservient thereto." Owing to other provisions of the will, it was not deemed advisable to begin the formation of the Bussey Institution earlier than 1870. In the same year, the trustees of the Massachusetts Society for Promoting Agriculture granted to the corporation of Harvard College a considerable sum "for the support of a laboratory and for experiments in agricultural chemistry, to be conducted on the Bussey estate." The laboratory of the new institution was not ready for occupation until the last week in 1871. As soon as it was completed, however, agricul-

tural researches were begun by F. H. Storer, the professor of agricultural chemistry, and his assistants. The first report of this work was presented to a committee of the trustees of the Massachusetts Society for Promoting Agriculture, December 3, 1871. The experiments consisted of field tests of fertilizers upon the farm of the institution, and chemical analyses of commercial fertilizers. Other interesting and valuable work was done in the next few years, but the great fire in Boston in 1872, and the commercial crisis of 1873, combined to cripple the institution financially, and it has since been able to make comparatively few original investigations. Meanwhile, as we have seen, agricultural colleges had been organized in a number of the States. Michigan led the way in 1857, and Maryland and New York soon followed her example. After the passage of the land-grant act in 1862, Kansas and Massachusetts were the first States to avail themselves of the national gift by establishing agricultural colleges, and thereafter the formation of these institutions proceeded with as much rapidity as could have been expected when the country was recovering from the direful effects of the civil war. Experimental work in agriculture was undertaken in several of these institutions soon after their organization.

The reports of the successful and beneficial work done in the European experiment stations excited more and more attention on this side of the Atlantic, and the more advanced leaders in agricultural progress in this country began to ask for the establishment of similar institutions in the United States. In 1872, at a convention of representatives of agricultural colleges held in Washington in response to a call issued by the United States Commissioner of Agriculture, the question of the establishment of experiment stations was discussed, and the report of a committee in favor of such institutions was adopted by the convention. On the 17th of December, 1873, at the winter meeting of the State Board of Agriculture, at Meriden, Conn., Prof. Johnson, of the Sheffield Scientific School, and Prof. Atwater, of Wesleyan University, urged the establishment of an agricultural experiment station in that State after the European pattern. A committee was appointed to consider the expediency of such a movement, and reported two days later that it was "their unanimous opinion that the State of Connecticut ought to have an experiment station as good as can be found anywhere, and that the legislature of the State ought to furnish the means for its establishment." A permanent committee was then appointed by the board to bring this matter to the attention of the public and the legislature. This committee held meetings in different parts of the State, and the following winter secured the introduction of a bill for an experiment station, which, however, was laid over until the next session of the legislature. Another year of agitation of the matter ensued. The project had many warm and enthusiastic friends, but, as might have been expected, the great mass of the farmers took little interest in the enterprise. When it had become apparent that it could not succeed, Mr. Orange Judd, the editor and proprietor of the *American Agriculturist*, offered on his own part $1,000 to begin the undertaking, and on the part of the trustees of Wesleyan University at Middletown the free use of the chemical laboratory in the Orange Judd Hall of Natural Science.

These offers were made on condition that the legislature should appropriate $2,800 per annum for two years for the work of the station. It was thought that if by these means the work of agricultural experimentation could actually be begun the usefulness of the enterprise would be so clearly demonstrated that it would speedily receive more generous and permanent support. An act making the appropriation thus proposed was unanimously passed, and approved July 2, 1875. Early in October of the same year a chemist was on the ground, and, as soon as practicable, two assistants were secured. Professor Atwater was made director, and thus the first agricultural experiment station in America was an accomplished fact. Notwithstanding the severe financial depression of 1877, which caused serious reduction

in old appropriations and utter refusal of new ones by the legislature of that year, a bill prepared by the director of the station and making a permanent annual appropriation of $5,000 "to promote agriculture by scientific investigation and experiment" was passed unanimously. At the end of the two years provided for in the original bill the station was reorganized under the direct control of the State, and permanently located in New Haven, where it has since been in successful operation until 1882, in the chemical laboratory of the Sheffield Scientific School, and thereafter in buildings and on grounds provided by the State in the suburbs of the city.

The success which attended this first attempt to establish an organized experiment station in the United States was sufficient to attract the attention of advanced agriculturists throughout the country, and the example set by Connecticut was soon followed by other States. In 1876, the University of California, at Berkeley, began systematic experimental work in agriculture, and on March 12, 1877, the State of North Carolina established a similar station at Chapel Hill in connection with the State University. The Cornell University Experiment Station was organized in February, 1879, by the faculty of agriculture of the University, as a voluntary organization. From that time until the passage of the act of Congress of March 2, 1887, the work was carried on by the different professors in time which could be spared from other studies. For a part of that time the trustees of the University appropriated money from the University funds to pay for the services of an analyst and for the purchase of supplies. All the other work was done without compensation. The New Jersey State Station at New Brunswick, N. J., was established March 18, 1880, by an act of the State legislature, and connected with the scientific school of Rutgers College. The movement grew in favor with the people with each succeeding year, and in 1886 the Committee on Agriculture, in reporting the Hatch bill to the House, was able to make the following statements:

"Since 1881 the legislatures of several States have either recognized or reorganized the departments of agriculture in the land-grant colleges as 'experiment stations,' thus following substantially the course adopted by New Jersey. Such stations have been established in Maine, Massachusetts, Ohio, Tennessee, and Wisconsin. In three other States (possibly more), without legislative action, the college authorities have organized their agricultural work as experiment stations. This has been done in California, Missouri, and New York. But in addition to the twelve experiment stations specifically designated by that name, a very large number of the colleges established under the act of 1862 are doing important work of a precisely similar kind. Many of them began such work immediately upon their establishment, and have since maintained it continuously; others have entered upon it more recently. The colleges in Colorado, Indiana, Kansas, Michigan, and Pennsylvania are carrying on what is strictly experiment station work as a part of their ordinary duty."

The convention of delegates of agricultural colleges which met at Washington in 1883 discussed and indorsed the project for the establishment of stations in connection with the colleges by appropriations from the National Treasury, in accordance with the terms of a bill already introduced in the House of Representatives by C. C. Carpenter, of Iowa. Congress, however, was not yet quite ready to undertake so large a scientific enterprise in this direction, and the bill was not put upon its passage. Meanwhile, the number of stations was steadily increasing, and the interest of practical farmers, as well as men of science, was more and more excited by the reports of the results of the experiments which the stations had completed. On the 8th of July, 1885, a convention of agricultural colleges and experiment stations met at the Department of Agriculture, at Washington, in response to a call issued by the Commissioner of Agriculture. Almost the first thing which this convention did was to pass a resolution, "That the condition and progress of American agriculture require national aid for the investigation and experimentation in the several

States and Territories; and that, therefore, this convention approves the principle and general provisions of what is known as the Cullen bill of the last Congress, and urges upon the next Congress the passage of this or a similar act." The Cullen bill was in its general provisions similar to the bill afterwards passed by Congress and now popularly known as the Hatch act. So earnest was the convention in this matter that it appointed a committee on legislation, which rendered very efficient service in securing the passage of the amended bill.

In a later session the convention passed resolutions urging the creation of a branch of the Department of Agriculture at Washington, which should be a special medium of intercommunication and exchange between the college and stations. and which should publish a periodical bulletin of agricultural progress, containing in a popular form the latest results in the progress of agricultural education, investigation, and experimentation in this and in all countries. Provision was also made for a permanent organization by the appointment of a committee to coöperate with the United States Commissioner of Agriculture in determining the time of meeting and the business of the next convention and in forming a plan for a permanent organization.

At the next session of Congress the experiment station enterprise was again called to the attention of the House of Representatives by the bill which was introduced by William H. Hatch, of Missouri, and referred to the Committee on Agriculture. This committee made a favorable report March 3, 1886, and nearly a year later the bill was passed by Congress and approved by President Cleveland, March 2, 1887.

The following statements show the most important features of the act:

"In order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under the direction of the college or colleges or agricultural department of colleges in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled 'An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts,' or any of the supplements to said act, a department to be known and designated as an 'agricultural experiment station.' "

The States which had already established stations separate from the colleges are authorized to apply the benefits of this act to those stations.

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical compositions of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

"In order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of

investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act."

The stations established under this act are required to make annual reports to the governor of the State or Territory in which they are respectively located, to the United States Secretary of Agriculture and to the Secretary of the Treasury of the United States, and to publish quarterly bulletins for free distribution to newspapers and farmers.

Each State or Territory which assents to the provisions of the act is to receive $15,000 per annum from the Treasury of the United States for the maintenance of the station.

On the 18th of October, 1887, the second convention of agricultural colleges and experiment stations convened at Washington. A permanent organization was effected, and the association was named "The Association of American Agricultural Colleges and Experiment Stations." George W. Atherton, LL. D., president of the Pennsylvania State College, was elected president of the association. This convention was deeply interested in securing the coördination of the work of the several stations and indorsed the action of previous conventions in urging the establishment of a central bureau. As the result of the efforts of this association, acting in harmony with the Commissioner of Agriculture, an appropriation for this purpose was included in the annual appropriation bill for the Department of Agriculture for the fiscal year ending June 30, 1889. To carry out the provisions of this bill the Commissioner of Agriculture instituted in October, 1888, an Office of Experiment Stations as a special branch of the Department of Agriculture.

In accordance with official interpretation of the act of March 2, 1887, by the Treasury Department, the stations were unable to draw the money contemplated until after the passage of a supplementary act, which was approved February 1, 1888. This financial difficulty delayed the establishment of the stations in many of the States. At the present time, however, experiment stations are organized in all the States and in the Territory of Dakota. In several States more than one station has been organized, and in some States there are several branch stations under one management. Counting these latter as single stations, the total number at present is forty-six, but counting the branch stations separately the total number is about sixty.

The total number of the officers of the stations is about three hundred and seventy. For the fiscal year ending June 30, 1889, $585,000 is appropriated from the United States Treasury to the stations, and $10,000 to the Office of Experiment Stations at Washington. In addition, the stations receive from the States and from other sources (as far as can be ascertained at this time) $125,400.

A complete report of the financial condition of the stations would undoubtedly increase this amount by several thousand dollars, so that it is safe to say that the total amount which will be expended by the stations during the current year will reach $725,000.

Most of the new stations are in actual operation. Bulletins have been published giving accounts of organization and of experimental and other work. The investigations cover a wide range of topics, and the stations have in nearly all cases manifested their wisdom by directing their investigations towards the solution of questions of special interest to the localities in which they are situated, without neglecting subjects of more general interest and wider application.

The experiment station enterprise is now equipped for its great work. From its beginning, fourteen years ago, in the laboratory of a Connecticut college, it has grown out to the farthest limits of our great land, and has enlisted the best colleges and universities and the ablest investigators of the country, and secured both State and national resources for its service. It has the favor not only of leading minds

in science and education but also of a great army of practical farmers, to whom it has already brought substantial benefits. As the Secretary of Agriculture has justly said: "Of all the scientific enterprises which the Government has undertaken, scarcely any other has impressed its value upon the people and their representatives in the State and national legislatures so speedily and so strongly as this. The rapid growth of an enterprise for elevating agriculture by the aid of science, its espousal by the United States Government, its development to its present dimensions in the short period of fourteen years, and, finally, the favor with which it is received by the public at large, are a striking illustration of the appreciation on the part of the American people of the wisdom and the usefulness of calling the highest science to the aid of the arts and industries of life.

"The present is an auspicious time for this undertaking. In the history of no nation before has there been such a thirst for knowledge on the part of the great masses of the people, such high and just appreciation of its value, and such wide-reaching, successful, and popular schemes for self-education; no other nation has so large a body of farmers of high intelligence; never before has the great agricultural public been so willing and indeed so anxious to receive with respect and use with intelligence the information which science offers; never before has science had so much to give. The prospects, then, for this, the largest scientific enterprise in behalf of agriculture that any government has undertaken, are full of promise."

HISTORY OF THE DEPARTMENT OF AGRICULTURE.

The establishment of a National Board of Agriculture was one of the measures which President Washington strongly urged upon the attention of Congress. The propriety of giving national aid to agriculture was considered by committees of both Houses of Congress in those early days, but the indifference of the farmers and constitutional objections prevented any legislative action. During the administration of John Quincy Adams instructions were given to the consuls of the United States in various quarters of the world to send to the Department of State rare seeds and plants for distribution, and about the same time a botanical garden was established at Washington. These measures proved to be the germs from which have grown the United States Department of Agriculture.

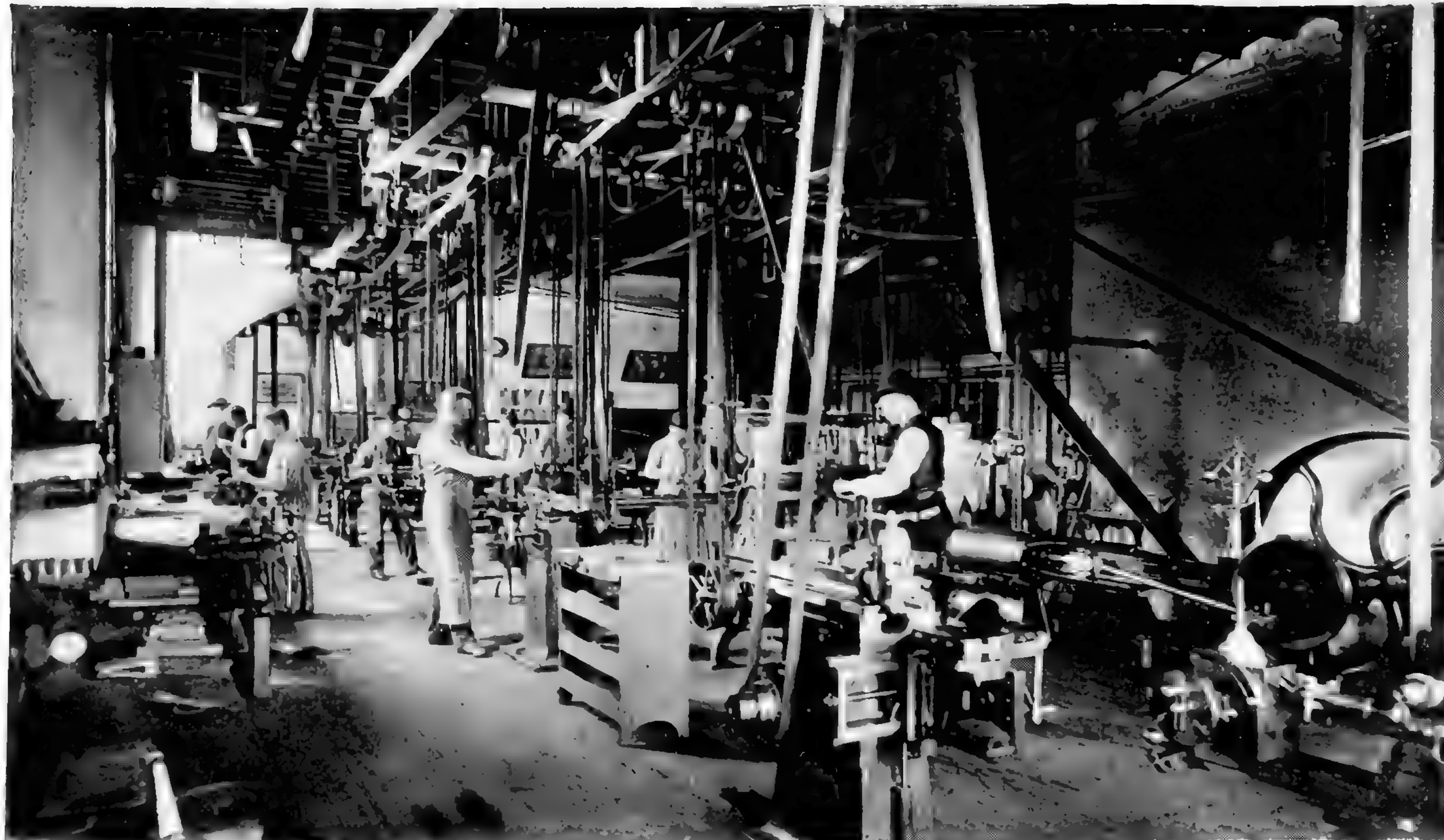
In the distribution of business to the several Departments of the Government organized shortly after the adoption of the Federal Constitution a century ago, it fell to the lot of the Department of State to have the principal charge of the issuing of patents, though for several years the Secretary of War and the Attorney-General were associated with the Secretary of State to form what may be called a Commission of Patents. For a quarter of a century the work of the Patent Office so called was so comparatively insignificant that the clerks employed in this office apparently had time for the discharge of other duties, and such small receipts and distributions of seeds as were actually made under the directions to the consuls were supervised by the Patent Office. Thus it came to pass, that when, on the 4th of July, 1836, the Patent Office was made a separate bureau of the Government, and Hon. Henry L. Ellsworth, of Connecticut, was appointed first Commissioner of Patents, this new official conceived the idea that it came within the proper scope of his office to help the farmers of the country by distributing seeds and plants. Mr. Ellsworth had been a practical farmer in Connecticut, and, as Indian Commissioner, had traveled far to the West, had been greatly impressed by the fertility of the vast prairies, and was deeply interested in projects for the opening of these lands to settlement. He also realized the importance of the invention of improved agricultural implements, which were then beginning to attract public attention, and believed that great benefit might result "from the establishment of a regular system for the selection and distribution of grains and seeds of the choicest varieties for agricultural purposes."

KANSAS STATE AGRICULTURAL COLLEGE, MAIN BUILDING.

MAIN BUILDING, UNIVERSITY OF ILLINOIS.

WELLS' HALL (STUDENTS' DORMITORY), MICHIGAN STATE AGRICULTURAL COLLEGE.

MAIN BUILDING OF THE ARKANSAS INDUSTRIAL UNIVERSITY.



MACHINE SHOP, SCHOOL OF MECHANICAL ENGINEERING, UNIVERSITY OF ILLINIOS.

SCIENCE HALL OF THE UNIVERSITY OF SOUTH CAROLINA.

EXPERIMENT STATION LABORATORY, UNIVERSITY OF ILLINOIS.

CHEMICAL LABORATORY, ALABAMA EXPERIMENT STATION.

LABORATORY OF THE MAINE STATE COLLEGE.

MASSACHUSETTS STATE EXPERIMENT STATION BUILDING.

FARM BUILDINGS OF THE NEW HAMPSHIRE STATE COLLEGE OF AGRICULTURE AND MECHANICAL ARTS.

AGRICULTURAL HALL, MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST, MASSACHUSETTS.

So earnest was the Commissioner of Patents in this matter that, without legal authorization and outside of office hours, he secured free gifts of seeds and plants, which he afterwards distributed to farmers in various sections of the country. In his first annual report, dated January 1, 1838, he made a strong plea for an appropriation to continue and enlarge this work. Congress paid no immediate attention to his recommendations, but with the help of friendly members of Congress, who freely lent their franks for this purpose, Mr. Ellsworth continued his self-imposed task. The favorable reports concerning the results obtained from the seeds and plants thus distributed, which soon began to come in from all parts of the country, proved the best arguments to arouse the attention of an indifferent Congress. "In the closing hours of the Twenty-fifth Congress (act of March 3, 1839), the Commissioner was gratified by the passage of an appropriation of $1,000, to be taken from the Patent Office fund, for the purpose of collecting and distributing seeds, prosecuting agricultural investigations, and procuring agricultural statistics. Thus originated the agricultural division of the Patent Office."

In the report dated January 1, 1841, the statement was made that 30,000 packages of seeds had been distributed during the preceding year, and that agricultural statistics based upon the returns of the census were being compiled. "The importance of an annual report of the state of the crops in different sections, as a preventive against monopoly and a good criterion to calculate the state of exchange," was urged upon the attention of Congress. In the next report were published tables based upon the census returns of 1840, supplemented by information obtained from agricultural reports, newspapers, and official correspondence with leading citizens in all parts of the country, and containing estimates of the products of agriculture in the United States for the year 1841. The comparatively small importance which was attached to this work in behalf of agriculture, and the opposition against which its early supporters had to contend, are indicated by the fact that in 1840 and 1841, and again in 1846, Congress failed to make any appropriation for this purpose. Even when appropriations were made they were small in amount, for "in no one year up to 1854 did the annual appropriation exceed $5,500, and it was generally below that sum."

In 1854 the policy of appropriating money from the Patent Office fund was abandoned, and in the following year the whole amount ($39,000) drawn from that fund in the interests of agriculture was reimbursed, and thereafter all appropriations for agriculture were drawn directly from the Treasury.

Mr. Ellsworth, after trying in vain to induce Congress to establish "an agricultural bureau, or at least an agricultural clerkship, at a moderate expense," or to make "a sufficient appropriation to allow a personal examination of the various parts of the country by some one well qualified for such duty," not only continued to distribute seeds and prepare agricultural statistics, but also wrote at some length on the condition and prospects of American agriculture. These essays of the Commissioner of Patents "challenge admiration by their comprehensiveness, their minuteness of detail, and the thorough acquaintance with the agricultural resources of the country manifested by the writer." This literary work was largely a "labor of love" performed out of office hours. At this time also was commenced the practice of publishing communications from farmers and others and from agricultural journals on practical questions relating to agriculture. In 1845 Mr. Ellsworth resigned and was succeeded by Hon. Edmund Burke, of New Hampshire. The new Commissioner of Patents devoted more than 1,000 pages of the report for 1845 to agricultural topics. Many new features were introduced, "prominent among which were tables of British and United States imports and exports and English cotton quotations." Congress seems to have considered such zeal for agriculture too extravagant, for it refused to make any appropriation for agricultural purposes

for the ensuing year. "When the Patent Office report for 1846 appeared agricultural statistics, essays, correspondence, and newspaper articles were entirely omitted." In the following year, however, the appropriation for agriculture was restored. "The report for that year was especially rich in statistics relating to the products of labor and capital in the United States, the movement of those and foreign products on interior lines of transportation, the cousumption and surplus for exportation of food products, the demands of foreign countries for these, and tables of population, property, prices, etc. The volume was more profusely and expensively illustrated than any which had preceded it." In 1848 the quantity of seed distributed had increased to 75,000 packages, and in this year for the first time mention is made of the testing of foreign seeds "by an intelligent gardener." In 1849 Hon. Thomas Ewbank, of New York, became Commissioner of Patents. Under the direction of the Secretary of the Interior, of whose Department the Patent Office is a branch, the compiling and editing of the agricultural portion of the annual report was committed to a "practical and scientific agriculturist." This official abandoned the practice of publishing agricultural statistics and filled the reports with elaborate scientific and practical essays. This precedent was followed for a number of years. The essayist was given more and more space and the crop correspondent less and less. About 1850 the agricultural and industrial "cabinet," meditated by Mr. Ellsworth, seems to have been begun. The annual report for 1853 refers in rather extravagant terms to the variety and value of the collection of seeds, fibers, insects, etc., which it contained.

In 1854 Congress seems to have awakened to the fact that great good had been done by the distribution of seeds, plants, and agricultural information. The annual appropriation was increased to $35,000, and has never since been less than that sum. A special agent was now employed "to investigate and report upon the habits of insects injurious and beneficial to vegetation, especially those infesting the cotton plant." In 1855 an arrangement was made with the Smithsonian Institution for procuring and publishing meteorological statistics. A chemist and botanist were also employed, and a propagating garden begun.

The interest in measures to promote agriculture by Government aid grew rapidly with each succeeding year. Boards of agriculture and agricultural colleges were established in a number of the States; agricultural societies and periodicals constantly increased in number and influence; Congress passed the Morrill bill to endow agricultural and mechanical colleges. President Buchanan vetoed this, but with a change of administration it was again successfully piloted through the national legislature and found favor in the eyes of the new Executive. The great agricultural West was every year a factor of greater importance in the national life, and after the withdrawal of the representatives of the Southern States from the halls of Congress, the demands of the progressive agriculturists of the States beyond the Alleghanies were listened to with more respect.

The first annual report of Commissioner David P. Holloway, of Indiana, is worthy of notice as the last and most complete agricultural manual issued by the Patent Office, as the most extreme representative of the reign of the agricultural essayist, and as containing a bold and able plea for the creation "of a Department of the Productive Arts, to care for all the industrial interests of the country, but especially for agriculture."

Congress adopted a portion of the Commissioner's plan, and passed a bill establishing a Department of Agriculture. This act became a law by the approval of President Lincoln on the 15th of May, 1862, and on the 1st of July of the same year the new Department was formally organized in the rooms of the Patent Office previously occupied by the agricultural division of that Bureau. Though by the terms of the act an independent Department of the Government was established, its chief

officer was to be styled Commissioner of Agriculture, and was not to be a member of the President's Cabinet. The full text of the act reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby established at the seat of government of the United States a Department of Agriculture, the general designs and duties of which shall be to acquire and diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word, and to procure, propagate, and distribute among the people new and valuable seeds and plants.

SEC. 2. *And be it further enacted*, That there shall be appointed by the President, by and with the advice and consent of the Senate, a "Commissioner of Agriculture," who shall be the chief executive officer of the Department of Agriculture, who shall hold his office by a tenure similar to that of other civil officers appointed by the President, and who shall receive for his compensation a salary of three thousand dollars per annum.

SEC. 3. *And be it further enacted,* That it shall be the duty of the Commissioner of Agriculture to acquire and preserve in his Department all information concerning agriculture which he can obtain by means of books and correspondence, and by practical and scientific experiments (accurate records of which experiments shall be kept in his office), by the collection of statistics, and by any other appropriate means within his power; to collect, as he may be able, new and valuable seeds and plants; to test, by cultivation, the value of such of them as may require such tests; to propagate such as may be worthy of propagation, and to distribute them among agriculturists, He shall annually make a general report in writing of his acts to the President and to Congress, in which he may recommend the publication of papers forming parts of or accompanying his report, which report shall also contain an account of all moneys received and expended by him. He shall also make special reports on particular subjects whenever required to do so by the President or either House of Congress, or when he shall think the subject in his charge requires it. He shall receive and have charge of all the property of the agricultural division of the Patent Office in the Department of the Interior, including the fixtures and property of the propagating garden. He shall direct and superintend the expenditure of all money appropriated by Congress to the Department, and render accounts thereof, and also of all money heretofore appropriated for agriculture, and remaining unexpended. And said Commissioner may send and receive through the mails, free of charge, all communications and other matter pertaining to the business of his Department, not exceeding in weight thirty-two ounces.

SEC. 4. *And be it further enacted*, That the Commissioner of Agriculture shall appoint a chief clerk, with a salary of two thousand dollars, who, in all cases during the necessary absence of the Commissioner, or when the said principal office shall become vacant, shall perform the duties of Commissioner, and he shall appoint such other employés as Congress may from time to time provide, with salaries corresponding to the salaries of similar officers in other Departments of the Government; and he shall, as Congress may from time to time provide, employ other persons, for such time as their services may be needed, including chemists, botanists, entomologists, and other persons skilled in the natural sciences pertaining to agriculture. And the said Commissioner and every other person to be appointed in the said Department shall, before he enters upon the duties of his office or appointment, make oath or affirmation truly and faithfully to execute the trust committed to him. And the said Commissioner and the chief clerk shall also, before entering upon their duties, severally give bonds, with sureties, to the Treasurer of the United States, the former in the sum of ten thousand dollars, and the latter in the sum of five thousand dollars, conditional, to render a true and faithful account to him or his successor in office, quarter-yearly accounts of all moneys which shall be by them received by virtue of the said office, with sureties to be approved as sufficient by the Solicitor of the Treasury, which bonds shall be filed in the office of the First Comptroller of the Treasury, to be by him put in suit upon any breach of the conditions thereof.

Approved May 15, 1862.

Hon. Isaac Newton, of Pennsylvania, who had been, since early in 1861, the superintendent of the agricultural division of the Patent Office, was appointed the first Commissioner of Agriculture. Mr. Newton had been a practical and progressive farmer, was one of the first and most active members of the State Agricultural Society of Pennsylvania, and had for years been urging upon Congress the importance of establishing such a department of agriculture as that over which he was

now called to preside. "Upon assuming the duties of his office he at once proceeded to organize the Department in accordance with the liberal spirit of the act creating it. The time was pregnant with mighty events, and every Department of the Government felt the stimulus of the grave perils which beset the very existence of the nation. The clerical force of the former agricultural division was increased; a chemist was engaged, and a laboratory established; a skilled horticulturist was placed in charge of the propagating or experimental garden; greater activity in the collection and dissemination of current agricultural facts was inaugurated, aud a larger quantity of seeds and cuttings was distributed.

"The first annual report of the Department was a great improvement on most of the reports which had preceded it. It treated mainly of fresh topics in agriculture and connected fields of investigation and development. But its most significant feature was the revival of the long-neglected agricultural statistics presented in connection with observations on the leading facts they developed, and followed by full tables of agricultural exports. The eighth census furnished the data for the tables of agricultural production. The important feature thus revived was specially required by the terms of the act creating the Department, and it has never since been omitted. A statistical branch was organized early in 1863, and to it was committed the collection and analysis of all statistics. Lewis Bollman, of Indiana, was appointed statistician. To ascertain at the earliest practical period the condition of the crops, their yield, the prices obtained for them, and other facts connected with current agricultural operations, the Commissioner issued during 1863 periodical circulars to farmers in every county of the loyal States. The results thus obtained were given to the public through the medium of monthly reports, which have been continued to the present day, with such modification of their original features as time and experience have seemed to render necessary. The first monthly report was issued July 10, 1863. The publication in the monthly reports of monthly and bimonthly meteorological tables furnished by the Smithsonian Institution was commenced at the same time. These tables were reproduced in the ensuing annual report. Up to 1872 the same arrangement concerning these tables continued in force, when their further publication was suspended.

"The employment of a skillful gardener was one of the most auspicious incidents of the first year of Mr. Newton's administration. He was fortunate in procuring the services of William Saunders, who has ever since given to the important duties assigned to him an intelligent and conscientious devotion.

"In the second year of Mr. Newton's administration (1863) the number of packages of seeds distributed was 1,200,000, and of bulbs, vines, cuttings, and plants, 25,750. Townsend Glover was appointed as entomologist. The annual report for 1863 contained the first attempt that had been made since the days of Ellsworth and Burke to engraft upon the census returns the statistics of the yearly progress of agricultural production. The tables given in its pages, compiled from the monthly reports, showed the average yield per acre of the several crops of 1863, and the average prices obtained for them in the month of November of that year. From that day until this the Department has aided greatly, by the publication of tables of this character, in protecting alike consumers and producers from the exactions of grasping speculators."

In 1864 the Government reservation in the city of Washington, lying between the Smithsonian Institution and the Washington Monument and embracing thirty-five acres, was assigned to the Department of Agriculture. For several years this land was chiefly used as an "experimental farm." When the large increase in the business of the Department made it necessary to erect a building for its enclusive use, the edifice was located on this farm. The building, a brick structure, costing over $100,000, was finished in 1868. It now contains the offices, laboratory, and library of the Department, but is greatly overcrowded, and must soon be enlarged or re-

placed by a new building. While the Department building was in process of erection, it was decided to abolish the experimental farm and convert the grounds into a landscape garden, comprising a collection of hardy trees and shrubs, arranged in their natural orders. Under the artistic direction of the superintendent of the garden these grounds were so laid out and planted as to be to-day among the most attractive in Washington.

The history of the Department for the years which follow down to the present time has been mainly one of development along the lines already indicated. It has added scientific branches one after another as the progress of agricultural science has demanded new divisions of the work, and the means at the disposal of the Department has enabled it to widen the range of its efforts. It has undertaken practical experiments for the protection and benefit of the farmer on a larger and larger scale, as success in its undertakings has demonstrated the wisdom of a liberal policy in its management. The annual appropriations placed at its command have risen to more than one and a half millions of dollars, the number of its employés is reckoned by thousands, and the aggregate of its yearly publications exceeds half a million of copies.

It will not be possible in this report to trace this progress step by step, to show how the limits of its influence have extended and its work increased in value alike to the scientist and the practical farmer. Suffice it to say that the Department has made such a record that it has received the increasing support and confidence of the agricultural, scientific, and general public, until at last it has been given that official rank, as an independent department of the Government, due to a branch of the Government service dealing with the interests in which half the population are directly concerned and on which the national prosperity mainly depends.

On the 11th of February, 1889, President Cleveland approved the act of Congress to create an executive department to be known as the Department of Agriculture, and nominated Norman J. Colman, of Missouri, the last Commissioner of Agriculture, to be the first Secretary of Agriculture. Mr. Colman took the oath of office February 15, in the presence of officers and employés of the Department.

With a change of administration, March 4, 1889, Mr. Colman retired from the office, and Jeremiah M. Rusk, of Wisconsin, was appointed Secretary of Agriculture by President Harrison. Edwin Willits, president of the Michigan Agriculture College and director of the experiment station connected with that institution, was appointed Assistant Secretary. Upon these two officials will largely rest the reorganization of the Department in its enlarged capacity and the determination of its policy for years to come.

At this crisis of its history it may be of interest to present to the student of American institutions a brief outline of the organization of this Department of the United States Government as it exists to-day. It will, of course, be understood that such a description of the organization and work of the several branches of this Department will necessarily fail to give any just conception of the great practical and scientific influence with the Department exerts and which is felt in every section of the land. And it must be remembered that the work of the Department is by no means confined to that which is done in the daily routine of the various offices. The lectures, articles, and papers prepared by the chief officers and members of the scientific staff of the Department, and presented to farmers' associations, scientific societies, and to the agricultural and general public are yearly assuming more importance as factors in promoting intelligent cultivation of the soil, and scientific skill, accuracy and success in the conduct of investigations which have not only a high abstract value, but also a directly practical aim. It is more and more the effort of the Department to discover, classify, and describe the facts and principles of agricultural science in the most thorough manner, in order that those facts and principles may be clearly understood and intelligently and successfully applied in the practice of agriculture on the tens of thousands of farms in the United States.

In its formal organization the Department of Agriculture is at present divided into the office of the Secretary, which includes the offices of the Secretary, Assistant Secretary, and chief clerk, who is also superintendent of the Department buildings; the division of accounts and disbursements, the library, the file and stationery room, and the folding room; the office of experiment stations; the bureau of animal industry; the divisions of statistics, entomology, chemistry, botany, pomology, ornithology, and mammalogy, microscopy, and forestry; the seed division; and the division of gardens and grounds.

LIST OF OFFICERS OF THE DEPARTMENT.

OFFICE OF THE SECRETARY OF AGRICULTURE.

Secretary, Jeremiah M. Rusk.
Assistant Secretary, Edwin Willits.
Chief Clerk, S. S. Rockwood.
Chief of Division of Accounts, B. F. Fuller.
Librarian, Mrs. E. H. Stevens.
Private Secretary to the Secretary, O. D. LaDow.

OFFICE OF EXPERIMENT STATIONS.

Director, W. O. Atwater.
Assistant Director, A. W. Harris.

BUREAU OF ANIMAL INDUSTRY.

Chief, D. E. Salmon.
Assistant Chief, A. M. Farrington.

DIVISION OF STATISTICS.

Statistician, J. R. Dodge.

DIVISION OF ENTOMOLOGY.

Entomologist, C. V. Riley.
Assistant Entomologist, L. O. Howard.
Chief of Silk Section, Phillip Walker.

DIVISION OF CHEMISTRY.

Chemist, Harvey W. Wiley.
Assistant Chemist, C. A. Crampton.

DIVISION OF BOTANY.

Botanist, George Vasey.
Chief of Section of Vegetable Pathology, B. T. Galloway,

DIVISION OF POMOLOGY.

Pomologist, H. E. Van Deman.

DIVISION OF ORNITHOLOGY AND MAMMALOGY.

Ornithologist, C. Hart Merriam.
Assistant Ornithologist, W. B. Barrows.

DIVISION OF MICROSCOPY.

Microscopist, Thomas Taylor.

DIVISION OF FORESTRY.

Chief, B. E. Fernow.

SEED DIVISION.

Chief, William M. King.
Superintendent of Seed Room, H. R. Branham.

GARDENS AND GROUNDS.

Horticulturist and Superintendent of Gardens and Grounds, William Saunders.

OFFICE OF THE SECRETARY OF AGRICULTURE.

THE SECRETARY OF AGRICULTURE.

JEREMIAH M. RUSK, of Wisconsin.

The duties of the Secretary of Agriculture are in general those which are incumbent on a member of the President's Cabinet, and those which were formerly performed by the Commissioner of Agriculture, in accordance with the terms of the original act of Congress establishing the Department. As a member of the President's Cabinet the Secretary of Agriculture acts as the adviser of the President not only on questions relating to the Department of Agriculture, but also on those regard-

ing the general policy of the administration of the Government. As the executive head of the Department, he is charged with the appointment of subordinate officials; acts as the medium of communication between the Department and Congress, the other branches of the Government, and the general public; determines the general policy of the Department; executes the laws passed by Congress which relate to his Department; and sets in operation movements of various kinds for the benefit of agriculture and for the enlightenment and guidance of the farmer in the theory and practice of the art of agriculture.

The business of the Department is very largely transacted in his name, and the moneys appropriated by Congress for general and special purposes are spent under his direction and at his discretion. Like all other heads of Executive Departments in the Government of the United States, he is responsible to the President for the faithful discharge of the trusts committed to him.

ASSISTANT SECRETARY OF AGRICULTURE.

Edwin Willits, of Michigan.

This office was established coincident with the enlargement of the powers and functions of the Department of Agriculture. The office is only partially organized as yet, but the following-named divisions of the Department have already been assigned to the office of the Assistant Secretary:

The Botanical Division, and the Section of Vegetable Pathology.
The Pomological Division.
The Microscopical Division.
The Chemical Division.
The Ornithological Division.
The Forestry Division.
The Entomological Division, and the Silk Section.
The Office of Experiment Stations.

The Assistant Secretary, in general, controls and directs the scientific policy and operations of the above-named divisions, and sections thereof, and all questions and correspondence involving the scientific work of said divisions and sections are submitted to him for his approval and signature.

CHIEF CLERK.

S. S. Rockwood.

The chief clerk is the executive officer of the Department, and is *ex officio* the superintendent of the Department buildings. He has entire charge of the clerical force of the Department, acts upon all leaves of absence, and, in general, exercises direct control over the entire working organization of the Department.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

B. F. Fuller, Chief.

The principal business of this division is to make up the pay rolls, pay the employés of the Department, receive, audit, correct, and pay all the bills of expense incurred in the transaction of the business of the Department, keep the books and records, and make up and present the accounts to the United States Treasury Department for final settlement. Here also are kept an account of Government property in the possession of the Department; a record of appointments, promotions, and discharges of employés; a record of proposals, contracts, leases, etc.; a record of receipts of articles from express companies; orders for supplies purchased by the

Department; requisitions for printing, by which the United States Treasurer's account with this Department is verified; and, in general, all the financial matters of the Department pass through this division. Inasmuch as a large number of distinct appropriations are made for the Department and separate accounts have to be kept, great care and accuracy are required in preparing, auditing, and entering the vouchers in the books and accounts.

The method of obtaining funds for the payment of salaries and bills is as follows: An estimate is made of the amount which will be required from the appropriation, and a requisition for these amounts is drawn on the Secretary of the United States Treasury. When this requisition has passed the Treasury Department, a warrant is issued for the amounts called for, and they are placed to the credit of the disbursing clerk of the Department of Agriculture on the books of the United States Treasury.

When supplies are needed for the Department, a requisition is made by the Secretary for whatever may be required, and is presented to this division. If there is an appropriation available for the purchase, an order is issued for the same, the goods are delivered to the division requiring them, and the bill is presented to this division in duplicate. This division then refers the bill to the chief of the division for which the supplies were purchased, he certifies that the goods have been received and legitimately applied, and that the prices charged are just and reasonable, and returns the bill to this division. The bill is then referred to the Secretary for his approval, and when approved is returned to this division, audited, and, if correct, is paid either by check drawn on the Treasurer of the United States or by cash drawn from him for that purpose. After payment has been made the bill is entered in the cash book, posted in the journal to the appropriation to which it belongs, and at the end of the quarter is made up with other accounts of the Department, and transmitted to the United States Treasury Department for final settlement.

LIBRARY.

Mrs. E. H. Stevens, Librarian.

The library of the Department now comprises about 18,000 volumes, and is mainly a valuable collection of scientific works on agriculture in all its various branches, including agriculture proper, botany, chemistry, entomology, horticulture, microscopy, pomology, statistics, etc. A large number of agricultural periodicals, scientific journals, and the publications of agricultural and scientific societies in this and foreign countries are regularly received either by exchange or purchase. Author and subject catalogues are kept on cards.

STATIONERY AND FILE ROOM.

The business done in this room may be arranged under the following heads:

(1) The keeping of an accurate account of all stationery and materials received for the use of the Department and the distributing of them to the various divisions, in accordance with the orders of the Secretary or the chief clerk, upon proper requisitions.

(2) The receiving, copying, recording, and mailing of all letters going from the Department, which may be sent to the room for that purpose.

(3) The receiving, recording, briefing, and filing all letters coming to the Department, which are sent to the room for that purpose.

(4) The preparation of replies to such letters on special topics as may be sent to the chief of the room for that purpose.

(5) The systematic arrangement for convenient reference of all letters and documents sent to the room.

(6) The receiving, prepaying, and mailing of all books, pamphlets, letters, and seeds for foreign mails, and the keeping of a daily account of the post-office stamps which may be thus used.

FOLDING ROOM.

In the folding room the publications of the Department are received, folded, directed, and mailed. The publications for 1888 included the following:

	No. of copies.
Annual Report of the Department	400,000
Circulars of Bureau of Animal Industry	25,000
Reports of Division of Statistics	199,000
Bulletins and circulars of—	
Botanical Division	30,500
Chemical Division	23,000
Pomological Division	1,500
Entomological Division	53,000
Ornithological Division	1,500
Forestry Division	16,000
Total	749,500

OFFICE OF EXPERIMENT STATIONS.

W. O. Atwater, Director.

In accordance with an act of Congress approved March 2, 1887, and by State authority there have been established in the United States forty-six agricultural experiment stations, employing over three hundred and seventy trained scientists and practical agriculturists. These stations receive annually from the General Government $585,000 and from the State governments and other sources more than $125,000 in addition, making a total of more than $710,000 annually devoted to agricultural experimenting in this country.

In order to coördinate the work of these stations, to collate and publish their results for the benefit of the whole country, to aid the stations in coöperative enterprises, to furnish a medium of communication between the stations of this country and those of other countries, and to provide a bureau of information on all matters relating to the history, present condition, and progress of agricultural science and education, there was established in October, 1888, under authority of Congress, a branch of this department to be known as the Office of Experiment Stations. For the work of this office Congress appropriated $10,000 for the current fiscal year and $15,000 for the next year, in addition to the sum appropriated for the experiment stations.

This office has already collected a large amount of information regarding the history and present condition of agricultural science and education in the United States, has made arrangements for the publication of monographs, experiment station bulletins, and farmers' bulletins on topics relating to agricultural science and practice, has begun a library of station publications, and has assisted in editing the proceedings of the convention of the Association of American Agricultural Colleges and Experiment Stations. The first of the series of Experiment-Station Bulletins has been published. It contains an introduction by the Secretary of Agriculture; a statement concerning the organization and first work of the office; tables showing the dates of organization, number of officers, and revenues of the stations in the United States; a list of agricultural schools and colleges in the United States, with locations and names of presidents; an organization list of experiment

stations, with names of members of governing boards and station staffs; the United States legislation regarding experiment stations; the rulings of the Treasury and Post-Office Departments on that legislation; a brief account of the experiment-station movement in the United States.

The office has also assisted the horticulturists of the stations in an effort to secure uniformity in methods of testing and reporting on new varieties of fruits, vegetables, etc., and has held a conference of representatives from a number of the stations, at which plans were formed for coöperative soil tests with fertilizers.

In order to ally the office as closely as possible with the experiment stations, personal visits are made to the stations by members of the office staff as often as other duties will permit.

As a bureau of information the office conducts an extensive correspondence.

BUREAU OF ANIMAL INDUSTRY.

D. E. Salmon, Chief.

The Bureau of Animal Industry was established by act of Congress May 29, 1884, and organized June 1, 1884. The work of the Bureau may be classified as follows:

(1) Investigations and reports upon the condition, protection, and use of the domestic animals of the United States.

(2) Investigations and reports as to the causes of contagious, infectious, and communicable diseases among domestic animals and the means of prevention and cure of such diseases.

(3) The collection of such information on the subjects embraced in 1 and 2 as shall be valuable to the agricultural and commercial interests of the country.

(4) Examinations and reports upon the best methods of treating, transporting, and caring for animals, and the means to be adopted in suppressing and extirpating pleuro-pneumonia.

(5) The investigation, suppression, and extirpation of pleuro-pneumonia by inspection, quarantine, and slaughter of affected animals, and disinfection of buildings, premises, and vehicles of transportation.

(6) Original scientific researches, conducted at the experimental station and laboratory at Washington, in relation to the aforesaid subject-matter.

(7) The direction and management of quarantine stations for imported cattle.

(8) Clerical work, including the briefing, indexing, and filing of the reports of inspectors of cattle, the extensive correspondence relating to sick animals, and the preparation of the reports of the Bureau for publication.

The plan pursued in carrying on the above-described work is as follows:

At the beginning of the year, and from time to time, the chief of the Bureau, after consultation with the Secretary of Agriculture, selects subjects embraced in divisions 1, 2, and 3 to be investigated and reported upon, and competent persons are appointed by the Secretary to make such investigations. The employés so selected are generally well-known men, who have made a reputation in the particular subject-matter they are appointed to investigate, and whose business connections give them unusual facilities for obtaining information. They reside in various parts of the United States, and in the course of their investigations they are required to travel from place to place in order to properly make the investigations required of them. When they have completed the work given them they forward their report to the chief of the Bureau, who, if he approves the same, submits it to the Secretary. This report, if of sufficient value to the country at large, is then incorporated in the annual report of the Bureau of Animal Industry and transmitted to Congress as required by law.

The method adopted for carrying on the work specified in division 5 is as follows:

The Secretary of Agriculture, upon the recommendation of the chief of the Bureau, details inspectors to investigate in regard to the prevalence of pleuro-pneumonia in localities where it is believed to exist. These inspectors report weekly or oftener to the chief of the Bureau, giving a detailed statement of the herds, animals, premises, and conditions of the same, together with the names of owners and dates of inspection. Wherever pleuro-pheumonia is discovered it is at once reported to the chief of the Bureau and to the chief inspector of the State in which the discovery is made, and a temporary quarantine is placed on the herd in which it is found. The chief inspector immediately visits the herd for the purpose of verifying the diagnosis of the inspector, and reports his conclusions to the Bureau. As an external diagnosis for pleuro-pneumonia is a subject of much difficulty and often inconclusive and unsatisfactory, the chief of the Bureau is frequently compelled to personally verify the diagnosis of the chief inspector. When he is satisfied of the actual existence of the disease the herd is placed in permanent quarantine. The diseased animals are purchased and slaughtered, or are condemned, appraised, and slaughtered by coöperation with State authorities. As soon as the herd has been disposed of, the premises and buildings are thoroughly disinfected and the quarantine raised. Meanwhile an inspector is directed to ascertain how the disease was communicated to the herd and to trace the animal or animals introducing it to the premises from which they came.

When pleuro-pneumonia is found in more than one herd in any locality a quarantine of the locality is established, the size of the district quarantined being fixed according to the recommendation of the chief of the Bureau. Notice of the quarantine is certified to the governor of the State in which the district lies, and is published in newspapers designated by the Secretary, and notice of the declaration of quarantine is sent to all transportation companies doing business in such district, and they are forbidden to transport any animals of the kind infected unless the same are examined and certified by an inspector of the Bureau to be free of, and not to have been exposed to, pleuro-pneumonia. The strictest scrutiny is maintained to prevent any violation of the quarantine and to guard against the spread of pleuro-pneumonia while it is being extirpated in the quarantined district. Whenever the chief of the Bureau is satisfied that the disease has been extirpated, the several quarantines established are removed and notice of the removal is given to all parties interested.

The quarantining of cattle from foreign countries, formerly in charge of the Treasury Department, has by act of Congress been placed under the control of this Department, and added to the duties of Animal Industry.

These quarantine stations are five in number, and are located at Littleton, Massachusetts; Garfield, New Jersey; Philadelphia, Pennsylvania; Patapsco, Maryland; and San Francisco, California. The importers of cattle are requested to take out a permit stating the number of cattle to be imported and the ports of shipment and landing. This secures for them accommodation at the quarantine station. On the arrival of vessels having cattle on board, the collector of customs notifies the superintendent of the station at that port, and the superintendent meets the vessel, examines and takes charge of the imported cattle, and places them in quarantine at the station for a period of ninety days. After this period, if it is found that these animals are free from all diseases, they are discharged from quarantine, and the importers are permitted to ship them wherever they desire. Full reports of this work, containing the name of the vessel, importer, number, breed of each lot of imported cattle, and the place and person to which they are finally sent, is forwarded to the Bureau and filed for future reference, and an account of this work is reported in the Bureau's annual report.

For the coming fiscal year $500,000 have been appropriated for the work of this

Bureau. Fifteen thousand dollars of this sum may be expended in continuing investigations regarding the causes and nature of hog cholera and swine plague, and the means for preventing and curing these diseases.

DIVISION OF STATISTICS.

J. R. Dodge, Statistician.

The work of this Division includes every department of agricultural statistics, in this country especially, and throughout the world so far as relates to foreign products that compete with those of the United States. It involves the record, tabulation, and coördination of such statistics of production, distribution, and consumption, the authorized data of governments, institutes, societies, boards of trade, and of individual experts. It requires the collation and record of prices, a series of invaluable statistics illustrating the action of the law of supply and demand, trade regulations and restrictions, monetary distribution, and even the changes caused by the arbitrary edicts of fashion.

The publications of this Division consist of an annual report, which is published in the annual volume issued by order of Congress; a monthly series of reports of the Statistician; occasional special reports involving more thorough statistical investigation of topics of present public interest; and maps and charts illustrating the statistics of agriculture. Of the monthly reports an edition of about 20,000 is issued, for the use of county reporters and for editors and writers, as it is practicable to furnish the information only through the medium of the press and not to the millions of individuals interested. The main purpose of the crop reports is to give accurate information of crop areas, conditions, and prospects for the information of producers and consumers, and for their protection against combinations and extortion in the handling of the products of agriculture. In this work the theory is accepted that the unadorned truth, without exaggeration or underestimate, is the best for the growers and buyers.

The crop-reporting section has a correspondent and three assistants in each county, including now about 2,400 producing counties. A monthly return, according to a formula furnished by the Statistician, is made from each county.

As the main inquiries occur annually in the same month, the correspondent knows precisely what is expected, and prepares for it. Occasionally a new subject of inquiry gives variety to the work. The regular investigations relate to the increase or decrease of farm animals, commercial distribution of farm products, condition of farm stock at the close of the winter, losses of farm animals during the year, condition of winter grain in the spring, the progress of spring planting, the relative area of the principal crops, condition of growing crops up to the time of ripening, yield per acre, and the product of the year. These comparisons are made for each county, which has a known status in production.

These returns come in from the 1st to the 6th day of each month, are tabulated and consolidated, and ready for inspection and revision by the seventh or eighth. A parallel investigation is made in each State under the direction of the State agents of the Department, and its results ready at the same time for comparison with those from county correspondents. The Statistician harmonizes these results, and calculates a general average from the State averages. In making these averages, a true expression of the local estimates is obtained by applying the percentage (of condition, area, or other subject of comparison) to the quantity produced or breadth of area, thus giving to each county its true importance as a factor in the State estimate. The following statement, representing the returns of condition in five counties in Illinois, will show how the county returns are extended, to make true mathematical averages, and mark plainly the radical possible difference between a "straight average," by a number of returns only, and a true average:

	Percentage of condition.	Normal crop.	Condition extended.
		Bushels.	*Bushels.*
McLean	98	11,976,581	11,737.049
Alexander	65	454,705	305,558
La Salle	100	11,148,779	11,148,779
Hardin	70	306,960	214,872
Massac	67	450,010	301,507
Total	400	24,337,035	23,707,765
Average	80	....	97.4

The straight average, which is all that is usually attempted in amateur or newspaper crop reporting, makes in this case a reduction of 20 per cent, when the real reduction is only 2.6 per cent.

A report of the status of European crops, on the first of each month, is received from our statistical agent in London, Deputy Consul-General Edmund J. Moffat, and published in the monthly report.

The section of freight rates collects the freight rates charged by transportation companies of the United States on the first day of each month, and prepares the returns for publication in the monthly reports. This section also supervises the work of the State statistical agents, which is similar, in a limited area, to the crop reporting work of the Statistician, and comprises also local special investigations.

The Division is also about to make a statistical survey of the States and Territories of the vast Rocky Mountain region, the agricultural capabilities of which are as yet comparatively unknown; and also, from time to time, a similar survey of the resources and products of the older States.

DIVISION OF ENTOMOLOGY.

C. V. Riley, Entomologist.

The Entomologist, with his field agents and assistants, devotes his time to studying the habits of insects injurious to agriculture, seeking for the best means of counteracting their ravages, and giving to the cultivators of the soil the desired information about the control of insect pests. The importance of this work may be readily seen from the well-established statistics regarding the losses occasioned by insects. The most careful estimates have placed the aggregate annual loss to American agriculture from the ravages of insects at between $300,000,000 and $400,000,000. In many cases the question of profitable agriculture is simply a question of ability of the farmer to conquer his insect foes. Insects outnumber plants in the ratio of five to one, and it is safe to say that three hundred thousand species are known, and very many yet remain to be described, A large proportion of these may be classified as injurious. From extensive and constant importation of new species and the large areas devoted to special crops, America is a paradise for injurious insects. In the vast majority of cases the habits of an insect must be known before a remedy can be intelligently suggested. The reports of this Division show that a large proportion of the insects investigated were not before classified as injurious. A large number of investigations upon prominent insects and the insects of special crops have been carried on by this Division during the past ten years, and much information concerning their habits and the means for their repression has been diffused by correspondence and through publications.

During the past year the division has begun the publication of a periodical bulletin, called Insect Life, in which are printed notes, reports of the progress of investigations, and short articles upon entomological subjects which are either too limited in scope or too disconnected to be used in the annual report or in the special bulle-

tins of this division. The numbers up to the present time have consisted of two signatures each and have been plentifully illustrated, a prominent feature being extracts from the correspondence of the division with farmers and others.

The work of the division proper may be classified as follows:

(1) Correspondence with persons desiring information concerning particular insects or upon economic entomology in general.

(2) The care of the insects sent in by correspondents and by field agents and the study of their life habits in confinement.

(3) The mounting and preserving of specimens of injurious and beneficial insects.

(4) The study of the habits of injurious species in the fields, including experimentation with remedies.

(5) The preparation of original reports, the editing of the reports of agents, and the preparation of illustrations. In case the damage done by an insect, especially one which is new in the rôle of a pest, is sufficiently great to warrant the expenditure, an assistant entomologist or a field agent is dispatched to the locality where the ravages are being committed, to study the habits of the insect, collect material for investigations at the Department, and experiment with the remedies suggested by the entomologist. The division has also carried on an apicultural experiment station, where the breeding of bees, the values of different varieties of bee-forage plants, the methods of wintering bees, the diseases of bees, and the remedies for the same have been the subjects of study.

SECTION OF SILK-CULTURE.

From the time of its establishment the division of entomology has done what it could to aid silk-culture in this country by the dissemination of eggs and correct information. But since 1884 the special appropriations made by Congress to promote this industry have enabled the division to equip and maintain a special section of silk-culture. The results of the experiments made have been sufficient to impress the country with the desirability of continuing them. In the appropriation bill for the present year Congress has appropriated $20,000 for collecting and disseminating information relating to silk-culture, for purchasing and distributing silkworm eggs, and for conducting at some point in the District of Columbia experiments with automatic machinery for reeling silk from the cocoon. The proceeds obtained from the sale of reeled silk and silk waste produced in these experiments are also to be applied to paying the expenses incurred in making the experiments. Moreover $7,500 are to be expended under the direction of the Woman's Silk-Culture Association of the United States, located at Philadelphia, and the Ladies' Silk-Culture Society of California, for the encouragement and development of the culture of raw silk, and $2,500 for the continuation of studies and experiments on the native silkworm of California by Joseph Neuman.

DIVISION OF CHEMISTRY.

Harvey W. Wiley, Chemist.

The division of chemistry makes such chemical investigations as will be likely to benefit agriculture by securing the introduction of new industries which will use the products of the field and by preventing the adulteration of fertilizers, foods, liquors, drugs, etc. Recent investigations have been those connected with dairy products and the substitutes for butter; lard and lard adulterations; the adulteration of coffee, tea, chocolate, spices, and condiments; the composition and value of baking powder and bakers' chemicals; commercial fertilizers; wines, fermented and malt liquors, and ciders. The largest undertaking committed to this division has been that relating to the processes of making sugar from sorghum cane.

The result of these experiments has not only been to prove the feasibility of making sugar from sorghum at profitable rates by the use of the diffusion process, but also to make a probable revolution in the methods of producing sugar from sugar cane. The division also endeavors as far as possible to prove new methods of analysis in agricultural chemistry and to adopt such of them as are shown to be reliable for the use of the agricultural chemists of the country.

DIVISION OF BOTANY.

George E. Vasey, Botanist.

It is the business of this division to make investigations regarding the vegetable productions of the country, especially such as have economic uses, such as are the subjects of cultivation in agriculture and grazing, and such as require consideration on account of their interference with the work of the farmer and stockgrower or are obnoxious on account of hurtful properties; to care for, preserve, and improve the botanical collections in the herbarium and museum of the Department; to conduct such correspondence as is assigned to the division, and to prepare material for publication in annual and special reports. The division is subdivided into the sections of botany and vegetable pathology.

The following brief summary from the last published report of the Department may serve to indicate the kind of scientific work which the botanical section is doing:

(1) An investigation of the grasses of the arid districts of the West and Southwest, particularly of Texas, New Mexico, Arizona, Nevada, and Utah. Some two hundred species of grasses were observed growing in different situations and soils, and about thirty of these species were selected as deserving of attention and experiment for purposes of cultivation. A bulletin of these investigations was published, which was embellished with drawings and descriptions of the most important varieties.

(2) Several new or interesting and promising forage plants were brought to the attention of the Department as presenting promising features for cultivation in special localities. One of these was the European forage plant known as Sainfoin or Asperset (*Onobrychis sativa*), which has recently attracted considerable attention in California and Nevada as giving promise of great value for cultivation on dry hills and mountain slopes.

A paper was also prepared on *Teosinte*, a forage grass which, by reason of the great quantity of its foliage, is very valuable for soiling and storing in silos wherever the climate will allow of its full development.

(3) Accounts of certain common weeds and the best methods for their eradication were given, and also an account of the cultivation of peppermint with a view to its use for medicinal and pharmaceutical purposes.

Suggestive papers on cross-fertilization and pollenization were published with a view to provoking further research and investigation.

SECTION OF VEGETABLE PATHOLOGY.

This section was established July 1, 1886, for the purpose of making investigation of the fungous diseases of cultivated plants, and conducting experiments to determine suitable and efficient remedies for these diseases. The section publishes the results of its investigations and experiments and answers the queries of correspondents in its line of work. It also makes collections and microscopical preparations of American and foreign fungi, so far as they have practical and economic relations. Its last published report contained copiously illustrated accounts of the diseases of the grape vine, potato blight and rot, strawberry leaf blight, apple scab,

bitter rot of apples, rust of beets, leaf rust of the cherry, peach, plum, etc., cotton leaf blight, anthracnose of the raspberry, blackberry, and bean, smut and rust of corn, etc.

DIVISION OF POMOLOGY.

H. E. Van Deman, Pomologist.

This division was established August 1, 1886, and has for its work the collection and publication of information regarding the fruits grown in this country and the study of foreign fruits and new varieties of fruits produced in this country with a view to promoting their introduction and general use. Colored and photographic illustrations are made of the important varieties received, showing the natural size, shape, and color of both the exterior and interior of the fruit, with the leaves and twigs characteristic of each. These are kept for comparison and reference, and reprints of a portion of them are made in the publications of the Department. A good deal of microscopical work is also done in the investigation of the complex questions with which pomology deals, especially those relating to the production of new varieties of fruit. There is of late a good deal of interest taken in this country in the growth of fruit, and it is beginning to be realized that a much greater variety of different species may be successfully grown in the wide range of climates and soils found within its boundaries. For this reason the correspondence of this division has steadily and rapidly increased in volume and importance.

DIVISION OF ECONOMIC ORNITHOLOGY AND MAMMALOGY.

C. Hart Merriam, Ornithologist.

Systematic work in economic ornithology was begun by the Department July 1, 1885, in connection with the division of entomology. The division of economic ornithology and mammalogy was established July 1, 1886. Its functions are to investigate the food, habits, distribution, and migration of North American birds and mammals in relation to agriculture, horticulture, and forestry. The regular work of the division consists in the collection of facts relating to the aforesaid subjects and in the preparation for distribution among farmers and others special reports and bulletins upon birds and mammals which affect the interest of the farmer, and also upon the migration and distribution of American species.

At the commencement of the investigation of the food habits of the various species it became evident that the study of a bird's habits in the field must be supplemented by a critical examination of the contents of its stomach in the laboratory. For this purpose a collection of the crops, gullets, and gizzards of birds was made, which now numbers upward of ten thousand specimens. The insect portion of the material obtained in making this collection was turned over to the entomologist for determination. The remainder was identified by the ornithologist and his assistants.

The work of the division has been greatly facilitated by coöperation with the American Ornithologists' Union, which has turned over to the division a vast quantity of original material accumulated by a large corps of trained observers.

In the prosecution of its investigations the division sends out carefully prepared circulars of inquiry to the secretaries of agricultural and horticultural societies, to the agricultural press, and to a large number of farmers and ornithologists throughout the country. Replies from three or four thousand observers are thus obtained from a single circular. These replies are collated and tabulated and the results published in a bulletin. The most important bulletins thus far issued have been those relating to the English sparrow and to the migration of birds in the Mississippi Valley. A very large amount of material is now on hand and is being worked

over. The inquiry concerning the food habits of the crow has resulted in the collection of a great mass of very interesting information which will be published as soon as the investigation is completed. The range of the work of the division on a single topic may be illustrated by a brief analysis of the bulletin on the English sparrow. The introduction contains a synopsis of the principal facts brought to light by the investigation, together with the deductions from the same and suggestions to legislative bodies and to the people in regard to the best methods of abating the sparrow scourge. Then follows a mass of information arranged under seven heads:

(1) Time and manner of first appearance of the English sparrow; present abundance and apparent rate of increase; kind and degree of assistance and protection afforded or withheld by man.

(2) Relation of the sparrow to other birds.

(3) Injury to trees and vines.

(4) Injury to fruits and garden vegetables.

(5) Injury to grain.

(6) Relation of the sparrow to injurious or other insects.

(7) Methods of restriction; suggestions for extermination; miscellaneous information.

The bulletins of this division are eagerly sought for and hundreds of requests are are made for them in advance of their publication.

DIVISION OF MICROSCOPY.

Thomas Taylor, Microscopist.

The work of this division varies considerably from year to year as it passes from the microscopical investigation of one substance to that of another. The particular line of its studies will often be determined by the immediate requirements of public interests or policy. A few examples will best reveal the general character of the work done in this division. The invention of oleomargarine and other substitutes for butter and their fraudulent sale as butter have led to the enactment of stringent laws to protect the dairymen and the general public. It is obviously very desirable to have a ready and accurate means of detecting these butter substitutes. This division therefore instituted investigations relating to the crystallography of butter, oleomargarine, and butterine, and, for purposes of comparison, the fats of wild and domestic animals. The result was the discovery of a practical means for preventing fraud. These studies have led on to others in the same direction in the endeavor to distinguish between the butter crystals of different breeds of cows and to discover means for detecting adulterations in the fats used in medicinal preparations and in the arts and manufactures.

At one time the division made an extensive investigation of the injurious fungi and prepared for the Exposition at New Orleans a comprehensive exhibit of water-colored drawings representing this work. This exhibit embraces over one thousand of the principal mycological species which prey upon living plants or are otherwise prejudicial to their healthy growth; it includes also illustrations of the edible and poisonous mushrooms found in the United States. This collection is now on permanent exhibition at the National Museum in Washington.

At the present time, the division is engaged in an investigation of the adulterations of the condiments of commerce and other food stuffs. Examinations of the relative tensile strength of textile fibers are also being made. In connection with the work of the division and in order to facilitate its exactness, the chief of the division has invented several new instruments of research in the line of his work, photographs and models of which will be placed on exhibition at the forthcoming Paris Exposition. The exhibit at the Paris Exposition, contributed by this division,

consists of two hundred and seventy-three microphotographs representing the varied crystalline formations of butters and other fats, of which one hundred and sixty-seven are photographs of butter and one hundred and six photographs of the crystals of other fats, including beeswax and cotton-seed oil stearin.

DIVISION OF FORESTRY.

B. E. Fernow, Chief.

The business of this division includes the collecting of information concerning forestry matters for publication and the answering of individual inquiries on this subject. The division endeavors, as far as the limited means at its disposal will allow, not only to meet the needs of the student of forestry problems and of the forest-planter, but also to aid in the general enlightenment of the people of this country regarding the importance of economizing and enlarging the forest resources of the nation. As yet, however, the country is not thoroughly aroused to the importance of this question, and the National Government expends only $10,000 annually to pay for experiments, investigations, and reports upon forestry and for the collection and distribution of valuable and economic forest-tree seeds and plants. Within the last two years the division has issued reports on the relations of the Government to forestry, on the relations of the railroads to forestry, and on the forest conditions of the Rocky Mountain region, in addition to the annual reports and circulars of smaller compass.

The investigations which have principally occupied the division during the past year lie in two directions; biological studies relating to the life history of our most important conifers and to the different methods by which the crop of various timbers should be grown, and technological investigations, dealing with the nature of the crop and the conditions which influence its quality.

The calls for the representation of the facts concerning forestry at public meetings are constantly increasing, and the chief of the division has attended many such meetings and by personal contact and impression sought to widen among our people the conception of the meaning of this economical science, a knowledge and appreciation of which are growing more and more necessary from year to year.

SEED DIVISION.

William M. King, Chief.

The first regular appropriation made for the distribution of seeds for experimental purposes by act of Congress was one of $1,000 (made March 3, 1839), which, at that time, was deemed a sufficient amount to appropriate "for the purpose of collecting and distributing seeds and prosecuting agricultural investigations." The average amount expended annually during the fourteen years dating from the time the first appropriation was made did not exceed the sum of $3,000. In 1854 the amount appropriated for the same purpose was $35,000, which has gradually been increased, until the appropriation for the distribution of seeds, plants, cuttings, etc., is now and has been for many years $100,000 annually, and the average weight of the seed distributed through the mail by the Department of Agriculture each year for the last five years, ending June 30, 1888, was 400,000 pounds, or 200 tons.

The primary object of the distribution of seed is to give increased value to production, to introduce new industries, to establish principles in regard to climatic influences on seed races, and from these to deduce facts which would point to the best geographical distribution of varieties and more rapidly introduce the best varieties of seeds or farm and garden plants into new States and Territories.

The business of this division is to receive such seeds as are purchased from reliable seedsmen and growers in this and foreign countries, and keep a correct and classified list of the same; to thoroughly test their germinating qualities and examine them carefully to ascertain whether they are free from weed seeds or eggs or larvæ of injurious insects before payment is made for them; to store them away systematically; to receive and care for all the miscellaneous supplies needed in the putting up and distributing of the seeds; to estimate the number of paper and cotton bags necessary for the reception of each variety, and to make the same; to prepare copy for labels, giving name of seed and, when deemed necessary, directions for planting and cultivation; to put up the seed in quantities suitable for distribution; to prepare large numbers of packages of the various kinds of seed; to fill by direction of the Secretary of Agriculture the orders of Senators, Representatives, or Delegates in Congress for their constituents, which take about two-thirds of the gross amount of seeds so put up, and to address the required number of franks and postal cards; to send the balance of the seeds to 4,200 State and county statistical agents of the Department, to experiment stations, to granges and other agricultural societies, and to miscellaneous applicants throughout the entire country, and to such persons in foreign countries as desire to effect an exchange of seed with this country; to keep sets of books in which entries are made of all seeds received and distributed, except those to members of Congress; to condense, classify, and preserve for future reference reports from those to whom the seeds have been sent; to make at the end of each fiscal year, June 30, an alphabetically arranged statement, giving in full the quantities, species, and varieties of seeds received by the bureau during the year, with a tabulated statement showing the distribution of seeds during the same period. and to do such other work as is essential to the usefulness and efficiency of the division.

In the management of the seed division special attention has been given to the making of such a distribution of seeds as would tend to the improvement of old and well known varieties, and to the introduction of new ones which, with proper care and cultivation, would enhance the agricultural interests of the nation. In the accomplishment of this work, not only has some attention been paid to the geological formation of the districts or sections to which the seeds are sent, but also to the altitude and to isothermal and hydrometrical conditions. It is a fixed principle governing the general distribution of seeds by the Department of Agriculture, to further the dissemination of as great a number of varieties over as wide an area as practicable, with the view of determining as quickly as possible their adaptiveness or nonadaptiveness to every locality in the United States.

DIVISION OF GARDENS AND GROUNDS.

William Saunders, Horticulturist and Superintendent.

The grounds occupied by the Department contain about 35 acres. A large part of this area is laid out as ornamental grounds, comprising trees, shrubs, lawns, roads, and walks. The trees and shrubs are arranged in accordance with their botanical classification, with due regard to landscape gardening. The conservatory and greenhouses aggregate in length 680 feet and cover a surface of about three-fourths of an acre. These buildings are used for the preservation of a large collection of economic plants, for the propagation and culture of ornamental plants for the Department grounds, and of economic plants for general or special distribution in localities throughout the United States suited to their successful growth. Among the plants thus grown for distribution are grapes, strawberries, tea plants, camphor plants, olives, date-palms, oranges, lemons, mangoes, pineapples, guava plants, figs,

etc. About twenty thousand ornamental plants are propagated for the Department every year, and about seventy-five thousand for distribution. The plants are distributed mainly by mail.

The superintendent of this division acts as landscape gardener and engineer, garden architect and horticulturist, makes suggestions as to the introduction of such foreign economic plants as are likely to be valuable to this country, and conducts an extensive correspondence in answer to questions relating to the cultivation of fruiting and other economic plants.

Appropriations for the Department of Agriculture for the fiscal year ending June 30, 1890.

	Salaries.	Miscellaneous expenses.	Total.
Office of the Secretary	$83,060		$83,060
Division of—			
Botany	10,500	$35,000	45,500
Pomology	3,500	4,000	7,500
Microscopy	3,700	1,000	4,700
Chemistry	11,900	11,000	22,900
Entomology	7,300	50,000	57,300
Economic Ornithology and Mammalogy	8,060	7,000	15,060
Experimental gardens and grounds	2,500	26,640	29,140
Museum	3,120	1,000	4,120
Seed division	8,440	100,000	108,440
Division of statistics	34,500	75,000	109,550
Forestry division	2,000	8,000	10,000
Bureau of animal industry			515,000
Printing at the Department			4,200
Books, etc., for library			2,000
Furniture, cases, and repairs			7,350
Postage			4,000
Contingent expenses			15,000
Experiments in sugar making from sorghum and beets			25,000
Experiment stations			585,000
Office of experiment stations			15,000
Total			1,669,770

LIST OF AGRICULTURAL SCHOOLS AND COLLEGES IN THE UNITED STATES.

ALABAMA.—*Auburn:* Agricultural and Mechanical College, Alabama Polytechnic Institute; president, William LeRoy Broun, M. A., LL. D. *Abbeville:* Southeast Alabama Agricultural School; principal, J. S. Espy, B. S. *Athens:* North Alabama Agricultural School; principal, C. L. Newman, B. S.

ARIZONA.—*Tucson:* College of Agriculture of the University of Arizona; president, Merrill P. Freeman.

ARKANSAS.—*Fayetteville:* Arkansas Industrial University; president, Edward Hunter Murfee, M. A., LL. D.

CALIFORNIA.—*Berkeley:* College of Agriculture of the University of California; president, Horace Davis, LL. D.; Dean, Irving Stringham, PH. D.

COLORADO.—*Fort Collins:* State Agricultural College of Colorado; president, Charles L. Ingersoll, M. S.

CONNECTICUT.—*Mansfield* (post-office, *Storrs*): Storrs Agricultural School; principal, B. F. Koons, M. A., PH. D. *New Haven:* Sheffield Scientific School; president, Timothy Dwight, D. D.; director, George J. Brush, LL. D.

DELAWARE.—*Newark:* Delaware College; president, Albert N. Raub, M. A., PH. D.

FLORIDA.—*Lake City:* Florida State Agricultural and Mechanical College; president, Frank L. Kern, M. A.

GEORGIA.—*Athens:* Georgia State College of Agriculture and Mechanic Arts of the University of Georgia; chancellor, William E. Boggs, D. D. *Cuthbert:* Southwest Georgia Agricultural College; president, Benjamin T. Hunter, M. A. *Dahlonega:* North Georgia Agricultural College; president, William S. Basinger, M. A. *Milledgeville:* Middle Georgia Military and Agricultural College; president, J. Colton Lynes, PH. D. *Thomasville:* South Georgia Agricultural College; president, G. M. Lovejoy.

ILLINOIS.—*Urbana:* College of Agriculture of the University of Illinois; regent, Selim H. Peabody, PH. D., LL. D.; dean, George E. Morrow, M. A.

INDIANA.—*Lafayette:* The School of Agriculture, Horticulture, and Veterinary Science of Purdue University; president, James H. Smart, LL. D.

IOWA.—*Ames:* Iowa State College of Agriculture and Mechanic Arts; president, W. I. Chamberlain, LL. D.

KANSAS.—*Manhattan:* Kansas State Agricultural College; president, George T. Fairchild, M. A.

KENTUCKY.—*Lexington:* Agricultural and Mechanical College of Kentucky; president, James K. Patterson, PH. D.

LOUISIANA.—*Baton Rouge:* Louisiana State University and Agricultural and Mechanical College; president, J. W. Nicholson, M. A.

MAINE.—*Orono:* Maine State College of Agriculture and the Mechanic Arts; president, Merritt C. Fernald, M. A., PH. D.

MARYLAND.—*Agricultural College:* Maryland Agricultural College; president, Henry E. Alvord, C. E.

MASSACHUSETTS.—*Amherst:* Massachusetts Agricultural College; president, Henry H. Goodell, M. A. *Jamaica Plain:* Bussey Institution of Harvard University; president, Charles W. Elliott, LL. D.; Dean, F. H. Storer, B. S., M. A.

MICHIGAN.—*Agricultural College:* Michigan Agricultural College; president, Oscar Clute, M. S.

MINNESOTA.—*St. Anthony Park:* College of Agriculture of the University of Minnesota; president, Cyrus Northrop, LL. D. State School of Agriculture of the University of Minnesota; principal, W. W. Pendergast.

MISSISSIPPI.—*Agricultural College:* Agricultural and Mechanical College of Mississippi; president, S. D. Lee. *Rodney:* Alcorn Agricultural and Mechanical College; president, John H. Burrus, M. A.

MISSOURI.—*Columbia:* Agricultural and Mechanical School of the University of the State of Missouri; chairman of faculty, M. M. Fisler, D. D.

NEBRASKA.—*Lincoln:* Industrial College of the University of Nebraska; acting chancellor, Charles E. Bessey, PH. D.

NEVADA.—*Reno:* School of Agriculture of the Nevada State University; president, Stephen A. Jones, M. A., PH. D.

NEW HAMPSHIRE.—*Hanover:* New Hampshire College of Agriculture and the Mechanic Arts (in connection with Dartmouth College); president, Samuel C. Bartlett, D. D., LL. D.; dean, Charles H. Pettee, M. A., C. E.

NEW JERSEY.—*New Brunswick:* Rutgers Scientific School of Rutgers College; president, Morrill Edward Gates, PH. D., LL. D., L. H. D.

NEW MEXICO.—*Las Cruces:* Agricultural College of New Mexico; president, Hiram Hadley, M. A.

NEW YORK.—*Ithaca:* College of Agriculture of Cornell University; president, Charles Kendall Adams, LL. D.

NORTH CAROLINA.—*Raleigh:* North Carolina College of Agriculture and Mechanic Arts; president, Alexander Q. Holladay.

OHIO.—*Columbus:* Ohio State University; president, William H. Scott, LL. D.

OREGON.—*Corvallis:* Oregon State Agricultural College; president, B. L. Arnold, M. A.

PENNSYLVANIA.—*State College:* Pennsylvania State College; president, George W. Atherton, LL. D.

RHODE ISLAND.—*Kingston:* Rhode Island State Agricultural School; principal, John H. Washburn, PH. D. *Providence:* Agricultural and Scientific Department of Brown University; president, Rev. Elisha Benjamin Andrews, D. D., LL. D.

SOUTH CAROLINA.—*Columbia:* College of Agriculture and Mechanic Arts of the University of South Carolina; president, John M. McBryde, PH. D., LL. D. *Orangeburg:* Claflin University, College of Agriculture and Mechanics' Institute; president, L. M. Dunton, D. D.

SOUTH DAKOTA.—*Brookings:* South Dakota Agricultural College; president, Lewis McLouth, M. A., PH. D.

TENNESSEE.—*Knoxville:* State Agricultural and Mechanical College of the University of Tennessee; president, Charles W. Dabney, jr., PH. D., LL. D.; dean, Thomas W. Jordan, M. A.

TEXAS.—*College Station:* Agricultural and Mechanical College of Texas; chairman of college faculty, Louis L. McInnis, M. A.

UTAH.—*Logan City:* Utah Agricultural College; president, Governor A. L. Thomas.

VERMONT.—*Burlington:* University of Vermont and State Agricultural College; president, Matthew H. Buckham, D. D.

VIRGINIA.—*Blacksburg:* Virginia Agricultural and Mechanical College; president, L. L. Lomax. *Hampton:* Hampton Normal and Agricultural Institute; president, Samuel C. Armstrong, LL. D.

WEST VIRGINIA.—*Morgantown:* West Virginia University; president, E. M. Turner, LL. D.

WISCONSIN.—*Madison:* College of Agriculture of the University of Wisconsin; president, T. C. Chamberlin, PH. D., LL. D.

LIST OF AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

The legal names, locations, and directors, of the agricultural experiment stations in the United States.

State.	Name of station.	Location.	Director.
Alabama	Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama. (Substations at Abbeville and Athens.)	Auburn	J. S. Newman.
Alabama	Canebrake Agricultural Experiment Station.	Uniontown	W. H. Newman, M. S.
Arizona	Agricultural Experiment Station of the University of Arizona.	Tucson	S. M. Franklin, PH. B.
Arkansas	Arkansas Agricultural Experiment Station. (Substations at Newport, Pine Bluff, and Texarkana.)	Fayetteville	A. E. Menke, D. S.
California	Agricultural Experiment Station of the University of California. (Substations at Cupertino, Fresno, Jackson, Mission San Jose, Paso Robles, and Tulare.)	Berkeley	E. W. Hilgard, PH. D., LL. D.
Colorado	Agricultural Experiment Station. (Substations at Del Norte and Rocky Ford.)	Fort Collins	C. L. Ingersoll, M. S.
Connecticut	Connecticut Agricultural Experiment Station.	New Haven	S. W. Johnson, M. A.
Connecticut	Storrs School Agricultural Experiment Station.	Storrs	W. O. Atwater, PH. D.
Delaware	Delaware College Agricultural Experiment Station.	Newark	A. T. Neale, PH. D.
Florida	Agricultural Experiment Station of Florida. (Substations at De Funiak, Fort Myers, and Ocala.)	Lake City	J. P. De Pass.
Georgia	Georgia Experiment Station	Griffin	R. J. Redding.
Illinois	Agricultural Experiment Station of the University of Illinois.	Champaign	S. H. Peabody, PH. D., LL. D.

The legal names, locations, and directors, of the agricultural experiment stations in the United States—Continued.

State.	Name of station.	Location.	Director.
Indiana	Agricultural Experiment Station of Indiana.	Lafayette	H. E. Stockbridge, PH. D.
Iowa	Iowa Agricultural Experiment Station.	Ames	R. P. Speer.
Kansas	Kansas Agricultural Experiment Station.	Manhattan	G. T. Fairchild, M. A.
Kentucky	Kentucky Agricultural Experiment Station.	Lexington	M. A. Scovell, M. S.
Louisiana	Sugar Experiment Station, No. 1.	Audubon Park, New Orleans.	W. C. Stubbs, PH. D.
Louisiana	State Experiment Station, No. 2	Baton Rouge	W. C. Stubbs, PH. D.
Louisiana	North Louisiana Experiment Station, No. 3.	Calhoun	W. C. Stubbs, PH. D.
Maine	Maine State College Agricultural Experiment Station.	Orono	W. H. Jor an, M. S.
Maryland	Maryland Agricultural Experiment Station.	Agricultural College.	H. E. Alvord, C. E.
Massachusetts	Hatch Experiment Station of the Massachusetts Agricultural College.	Amherst	H. H. Goodell, M. A.
Massachusetts	Massachusetts State Agricultural Experiment Station.	Amherst	C. A. Goessmann, PH. D.
Michigan	Experiment Station of Michigan Agricultural College.	Agricultural College.	O. Clute, M. S.
Minnesota	Agricultural Experiment Station of the University of Minnesota.	St. Anthony Park.	N. W. McLain, LL. B.
Mississippi	Mississippi Agricultural Experiment Station.	Agricultural College.	S. M. Tracy, M. S.
Missouri	Missouri Agricultural College Experiment Station.	Columbia	E. D. Porter, PH. D.
Nebraska	Agricultural Experiment Station of Nebraska.	Lincoln	L. E. Hicks, PH. D.
Nevada	Nevada Agricultural Experiment Station.	Reno	S. A. Jones, PH. D.
New Hampshire	New Hampshire Agricultural Experiment Station.	Hanover	G. H. Whitcher, B. S.
New Jersey	New Jersey Agricultural College Experiment Station.	New Brunswick	M. E. Gates, PH. D., LL. D.
New Jersey	New Jersey State Agricultural Experiment Station.	New Brunswick	M. E. Gates, PH. D., LL. D.
New Mexico	Agricultural Experiment Station of New Mexico.	Las Cruces	H. Hadley, M. A.
New York	Cornell University Agricultural Experiment Station.	Ithaca	I. P. Roberts, M. Agr.
New York	New York Agricultural Experiment Station.	Geneva	P. Collier, PH. D.
North Carolina	North Carolina Agricultural Experiment Station.	Raleigh	H. B. Battle, PH. D.
Ohio	Ohio Agricultural Experiment Station.	Columbus	C. E. Thorne.
Oregon	Oregon Experiment Station	Corvallis	E. Grimm, B. S.
Pennsylvania	The Pennsylvania State College Agricultural Experiment Station.	State College	H. P. Armsby, PH. D.
Rhode Island	Rhode Island State Agricultural Experiment Station.	Kingston	C. O. Flagg, B. S.
South Carolina	South Carolina Agricultural Experiment Station.	Columbia	J. M. McBryde, PH. D., LL. D.
South Dakota	South Dakota Agricultural Experiment Station.	Brookings	L. McLouth, PH. D.
Tennessee	Tennessee Agricultural Experiment Station.	Knoxville	C. W. Dabney, jr., PH. D.
Texas	Texas Agricultural Experiment Station.	College Station	F. A. Gulley, M. S.
Utah	Agricultural Experiment Station of Utah.	Logan City	J. W. Sanborn, B. S.
Vermont	Vermont State Agricultural Experiment Station.	Burlington	W. W. Cooke, M. A.
Virginia	Virginia Agricultural Experiment Station.	Blacksburg	W. B. Preston.
West Virginia	West Virginia Agricultural Experiment Station.	Morgantown	J. A. Myers, PH. D.
Wisconsin	Agricultural Experiment Station of the University of Wisconsin.	Madison	W. A. Henry, B. Agr.

CHRONOLOGICAL TABLE OF THE ORGANIZATION OF THE EXPERIMENT STATIONS IN THE UNITED STATES.

The following table has been compiled from the data accessible to this office up to the present time.

Unless otherwise specified the reorganization of the stations referred to in this table is that which took place under the act of Congress of March 2, 1887.

The dates of the organization of the agricultural experiment stations in the United States, arranged in chronological order.

State.	Name of station.	Date of organization.	Remarks.
Conn	Connecticut Agricultural Experiment Station.	Oct. 1, 1875	First established in Middletown; reorganized in New Haven in 1877.
Cal	Agricultural Experiment Station of University of California.	—— —, 1876	Reorganized, March, 1888; outlying stations at Paso Robles, Tulare, Jackson, Cupertino, Fresno, and Mission San Jose.
N. C	North Carolina Agricultural Experiment Station.	Mar. 12, 1877	Reorganized in 1887.
N. Y	Cornell University Agricultural Experiment Station.	Feb. —, 1879	By faculty of agriculture of Cornell University; reorganized October 26, 1887.
N. J	New Jersey State Agricultural Experiment Station.	Mar. 18, 1880	
N. Y	New York Agricultural Experiment Station.	Mar. 1, 1882	
Ohio	Ohio Agricultural Experiment Station.	Apr. 25, 1882	Reorganized April 2, 1888.
Tenn	Tennessee Agricultural Experiment Station.	June 8, 1882	By trustees of University of Tennessee; reorganized 1887.
Mass	Massachusetts State Agricultural Experiment Station.	July —, 1882	Reorganized March, 1888.
Ala	Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama.	June —, 1883	By State; reorganized April 1, 1888.
Wis	Agricultural Experiment Station of University of Wisconsin.	Oct. 1, 1883	Reorganized 1888.
Me	Maine State College Agricultural Experiment Station.	Mar. 3, 1885	Reorganized October 1, 1887.
Ky	Kentucky Agricultural Experiment Station.	Sept. —, 1885	By trustees of college; reorganized by State April, 1886; reorganized under national authority, 1888.
Ala	Canebrake Agricultural Experiment Station.	—— —, 1885	By State.
La	Sugar Experiment Station, No. 1	Oct. —, 1885	By Sugar Planters' Association.
La	State Experiment Station, No. 2	Jan. —, 1886	By State bureau of agriculture.
Vt	Vermont State Agricultural Experiment Station.	Dec. —, 1886	By State.
Pa	Pennsylvania State College Agricultural Experiment Station.	June 30, 1887	
Nebr	Agricultural Experiment Station of Nebraska.	July 1, 1887	
Ind	Agricultural Experiment Station of Indiana.	July 1, 1887	
S. C	South Carolina Agricultural Experiment Station.	Jan. —, 1888	Consolidated in March, 1888, with station established by State in September, 1887.
Nev	Nevada State Agricultural Station	Jan. 2, 1888	
Mo	Missouri Agricultural Experiment Station.	Jan. 2, 1888	
Tex	Texas Agricultural Experiment Station.	Jan. 25, 1888	
Miss	Mississippi Agricultural Experiment Station.	Feb. 1, 1888	
Kans	Kansas Agricultural Experiment Station.	Feb. 8, 1888	
Iowa	Iowa Agriculture Experiment Station	Feb. 17, 1888	
Colo	Agricultural Experiment Station of Colorado.	Feb. 21, 1888	Substations at Del Norte and Rocky Ford.
Mich	Experiment Station of Michigan Agricultural College.	Feb. 21, 1888	
Oregon	Oregon Experiment Station	Mar. —, 1888	
Mass	Hatch Experiment Station of Massachusetts Agricultural College.	Mar. 2, 1888	
Md	Maryland Agricultural Experiment Station.	Mar. 9, 1888	
R. I	Rhode Island State Agricultural Experiment Station.	Mar. 23, 1888	
Conn	Storrs School Agricultural Experiment Station.	Mar. 29, 1888	

The dates of the organization of the agricultural experiment stations, etc.—Continued.

State.	Name of station.	Date of organization.	Remarks.
Ill......	Agricultural Experiment Station of University of Illinois.	Apr. 1, 1888	
La.....	North Louisiana Experiment Station, No. 3.	Apr.—, 1888	
Va.....	Virginia Agricultural Experiment Station.	May —, 1888	
Del	Delaware College Agricultural Experiment Station.	May —, 1888	
Ark...	Arkansas Agricultural Experiment Station.	—— —, 1888	Subtations at Pine Bluff, Newport, and Texarkana.
Dak....	Dakota Agricultural Experiment Station.	—— —, 1888	
Fla	Agricultural Experiment Station of Florida.	—— —, 1888	
Ga.....	Georgia Agricultural Experiment Station.	—— —, 1888	
Minn...	Agricultural Experiment Station of University of Minnesota.	—— —, 1888	
N. H...	New Hampshire Agricultural Experiment Station.	—— —, 1888	
N. J ...	New Jersey Agricultural College Experiment Station.	—— —, 1888	
W. Va	West Virginia Experiment Station.	—— —, 1888	

NUMBER OF STATION WORKERS AND THE REVENUES OF THE EXPERIMENT STATIONS IN THE UNITED STATES.

The following table has been complied from the data reported to this office by the stations up to the date of this writing.

Table showing the number of officers composing the station staffs of the Agricultural Experiment Stations in the United States, and the revenues of those stations for the fiscal year ending June 30, 1889, *from the United States, under the act of Congress of March* 2, 1887, *from the several States and from other sources.*

State.	Name of station.	No. in staff.	Annual revenue.		Total.
			From United States.	From other sources.	
Alabama..........	Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama.	10	$13,000	*a* $10,000	$23,000
Alabama....... ...	Canebrake Agricultural Experiment Station.	2	2,000	*b* 2,500	4,500
Arkansas..........	Arkansas Agricultural Experiment Station.	10	15,000	... .	15,000
California..........	Agricultural Experiment Station of University of California.	16	15,000	*c* 13,000	28,000
Colorado	Agricultural Experiment Station of Colorado.	12	15,000	....	15,000
Connecticut........	Connecticut Agricultural Experiment Station.	9	7,500	*b* 8,000 *d* 3,100	18,600
Connecticut........	Storrs School Agricultural Experiment Station.	5	7,500	... .	7,500
Dakota	Dakota Agricultural Experiment Station.	11	15,000	....	15,000
Delaware	Delaware College Agricultural Experiment Station.	5	15,000	....	15,000
Florida	Agricultural Experiment Station of Florida.	....	15,000	....	15,000
Georgia..........	Georgia Agricultural Experiment Station.	7	15,000	....	15,000
Illinois............	Agricultural Experiment Station of University of Illinois.	9	15,000	....	15,000

a Fertilizer fees.
b State appropriation.
c State appropriation and other sources.
d Analysis fees, etc.

Table showing the number of officers composing the station staffs of the Agricultural Experiment Stations in the United States, etc.—Continued.

State.	Name of station.	No. in staff.	Annual revenue.		Total.
			From United States.	From other sources.	
Indiana	Agricultural Experiment Station of Indiana.	9	$15,000	*e* $2,000	$17,000
Iowa	Iowa Agricultural Experiment Station	11	15,000	....	15,000
Kansas	Kansas Agricultural Experiment Station.	12	15,000	....	15,000
Kentucky	Kentucky Agricultural Experiment Station.	8	15,000	*d* 1,500	16,500
Louisiana	Sugar Experiment Station, No. 1	7	5,000	*b* 2,000 *f* 10,000 *g* 1,400	18,400
Louisiana	State Experiment Station No. 2	4	5,000	*b* 2,000 *g* 1,400	8,400
Louisiana	North Louisiana Experiment Station, No. 3.	2	5,000	*b* 2,000 *h* 5,000	12,000
Maine	Maine State College Agricultural Experiment Station.	10	15,000	....	15,000
Maryland	Maryland Agricultural Experiment Station.	[illegible]	15,000	....	15,000
Massachusetts	Massachusetts State Agricultural Experiment Station.	7	....	*b* 10,000	10,000
Massachusetts	Hatch Experiment Station of Massachusetts Agricultural College.	8	15,000	....	15,000
Michigan	Experiment Station of Michigan Agricultural College.	18	15,000	....	15,000
Minnesota	Agricultural Experiment Station of University of Minnesota.	12	15,000	....	15,000
Mississippi	Mississippi Agricultural Experiment Station.	10	15,000	....	15,000
Missouri	Missouri Agricultural College Experiment Station.	[illegible]	15,000	....	15,000
Nebraska	Agricultural Experiment Station of Nebraska.	[illegible]	15,000	....	15,000
Nevada	Nevada State Agricultural Station	5	15,000	....	15,000
New Hampshire	New Hampshire Agricultural Experiment Station.	9	15,000	....	15,000
New Jersey	New Jersey State Agricultural Experiment Station.	[illegible]	....	*b* 11,000	11,000
New Jersey	New Jersey Agricultural College Experiment Station.	5	15,000	....	15,000
New York	New York Agricultural Experiment Station.	7	....	*b* 20,000	20,000
New York	Cornell University Agricultural Experiment Station.	13	15,000	....	15,000
North Carolina	North Carolina Agricultural Experiment Station.	[illegible]	15,000	*b* 2,200	17,200
Ohio	Ohio Agricultural Experiment Station	7	15,000	....	15,000
Oregon	Oregon Experiment Station	3	15,000	....	15,000
Pennsylvania	Pennsylvania State College Agricultural Experiment Station.	10	15,000	*c* 3,000	18,000
Rhode Island	Rhode Island State Agricultural Experiment Station.	1	15,000	....	15,000
South Carolina	South Carolina Agricultural Experiment Station.	13	15,000	*g* 5,000	20,000
Tennessee	Tennessee Agricultural Experiment Station.	7	15,000	*g* 800	15,800
Texas	Texas Agricultural Experiment Station	11	15,000	....	15,000
Vermont	Vermont State Agricultural Experiment Station.	8	15,000	*b* 3,500 *e* 1,000	19,500
Virginia	Virginia Agricultural Experiment Station.	5	15,000	....	15,000
West Virginia	West Virginia Experiment Station	5	15,000	....	15,000
Wisconsin	Agricultural Experiment Station of University of Wisconsin.	8	15,000	*b* 4,000 *e* 1,000	20,000
	Total	369	585,000	125,400	710,400
District Columbia	United States Department of Agriculture, Office of Experiment Stations.	......	10,000	....	10,000
	Grand total	......	595,000	125,400	720,400

e Proceeds of farm. *f* Sugar Planters' Association. *g* Tax on fertilizers. *h* Parish of Ouachita.

Synopsis of the four-years' course in agriculture in colleges in several States.

Year.	Massachusetts.	New York.	Pennsylvania.	Mississippi.	Kansas.	Michigan.	California.
I	Agric		Agric	Agric		Agric	
				Hort			
	Chem	Chem	Chem	Nat. phil			Chem.
	Min						
	Bot				Bot	Bot	
		Physiol					
		Zoöl					
		Entom					
					Arith		
	Alg	Math		Alg	Alg	Alg	Math.
	Geom					Geom	
	Lat	Fr. or Ger.	Ger	Ger			Fr. or Ger.
	Engl	Engl	Engl	Engl	Engl	Engl	Engl.
			Rhet			Rhet	
				Hist	Hist	Hist	
	Draw	Draw	Draw	Draw	Draw	Draw	
			Rur. econ		Bk. keep		
		Phys. cult			Shop work		Phys. cult.
	Mil. tact	Mil. tact	Mil. tact		Mil. tact		Mil. tact.
II	Agric			Agric	Agric	Agric	
	Hort				Hort	Hort	
		Phys				Phys	Phys.
		Chem	Chem	Chem	Chem	Chem	Chem.
	Geol				Min		
	Bot	Bot	Biol			Bot	Bot.
	Physiol	Anat		Physiol	Physiol		
		Micros		Entom	Entom		
						Alg	
		Math		Geom	Geom	Geom	Geom.
	Trig					Trig	
	Survey		Survey	Survey		Survey	
	Fr		Ger				Fr. or Ger.
	Engl	Engl		Engl		Engl	Engl.
		Pol. econ	Hist				
	Draw			Draw			
			Mech. arts		Industrial	Mech	Phys. cult.
	Mil. tact	Mil. tact			Mil. sci	Mil. tact	Mil. tact.
III	Agric	Electives in agric., hort., vet. sci., chem., bot., geol., entom., survey., civ. eng., etc.	Agric	Vet. sci		Agric	
	Hort. & fores		Hort	Hort		Hort	
	Phys		Phys		Phys	Phys	Phys.
	Chem			Chem	Chem	Chem	Chem.
			Min	Geol			Min.
			Bot	Bot			
			Anat	Physiol	Physiol	Physiol	Physiol.
	Zoöl						Zoöl.
	Entom			Entom		Entom	Entom.
	Mech			Anal. geom	Mech. & trig	Mech	
				Mech	Survey		Survey.
							Fr. or Ger.
	Engl			Engl		Engl	Engl.
	Rhet				Rhet		
					Hist. and civ. go		Hist. & pol. econ.
		Draw		Draw	Industrial		
	Mil. tact			Mil. tact		Mil. tact	Mil. tact.
IV	Agric	Electives in agric., hort., vet. sci., chem., bot., geol., entom., survey., civ. eng., etc.	Agric	Agric	Agric		Agric.
			Hort. & for		Hort	Hort. & for	Hort.
	Vet. sci		Vet. sci		Vet. sci.	Vet. sci	
					Phys	Phys	Astron.
	Chem			Chem			
	Geol		Geol		Geol	Geol	Geol.
				Bot	Bot	Bot	Min.
				Zoöl	Zoöl	Zoöl	
	Meteor				Meteor	Meteor	
			Entom				
				Civ. eng		Civ. eng	
	Engl			Engl	Engl	Engl	
	Pol. econ		Pol. econ	Pol. econ	Pol. econ	Pol. econ	Pol. econ.
	Const. hist		Const. law	Const. law	Const	Const	
	Psychol				Psychol	Psychol	
	Farm law		Inter. law				
		Thesis	Thesis		Industrial		
	Mil. sci	Mil. sci		Mil. sci			Mil. tact.

Appendix I.

[CIRCULAR OF ANNOUNCEMENT.]

U. S. Department of Agriculture,
Exhibit by the Commissioner of Agriculture,
Washington, D. C., November 9, 1888.

By joint resolution approved May 10, 1888, Congress formally accepted the invitation of the French Republic to take part in the Paris Universal Exposition of 1889, and made an appropriation to defray the expenses incident to the collection and installation of the American exhibit. It was provided that a commissioner-general, and an assistant commissioner-general should be appointed to frame rules and regulations for the undertaking, and, under the direction of the Secretary of State, to control the expenditures to which it might give rise; and that as assistants to the Commissioner-General, nine scientific experts, to be assigned to the nine groups into which the French authorities have divided the Exposition, should be appointed by the President. It was furthermore made the duty of the Commissioner of Agriculture to collect and prepare suitable specimens of the agricultural productions of the several States and Territories.

In accordance with the provisions of this resolution of Congress, arrangements have been duly made between Gen. William B. Franklin, Commissioner-General and Norman J. Colman, Commissioner of Agriculture, for preparing that part of the exhibit for which the latter is responsible.

The undersigned, having been appointed by the President as one of the assistants to the Commissioner-General and assigned to Group VIII (agricultural products), has also been designated by the Commissioner of Agriculture as his representative to prepare the agricultural exhibit, and a board has been formed in the Department of Agriculture, consisting of the undersigned, Mr. William Saunders, Mr. O. D. La Dow, Mr. M. Trimble, and Dr. D. E. Salmon, to consider and decide upon all questions relating to the agricultural exhibit.

A subdivision of the work into various branches has been made, to facilitate the collecting and preparing of material for the exhibit, and special agents have been assigned as follows:

1. *Grains*—Mr. George William Hill, of St. Paul, Minnesota.
2. *Citrous and other fruits*—Mr. H. E. Van Deman, of the Department of Agriculture, Washington, D. C.
3. *Cotton and fibers*—Col. James R. Binford, of Duck Hill, Mississippi, and Mr. Charles Richards Dodge, of Boston, Massachusetts.
4. *Viticulture*—Mr. B. F. Clayton, of New York, and Mr. George Husmann, of Napa City, California.
5. *Tobacco and peanuts*—Mr. Alexander McDonald, of Lynchburg, Virginia.
6. *Agricultural education and experiment stations*—Prof. W. O. Atwater, of this Department.
7. *Vegetables, including hops and cranberries*—Mr. M. G. Kern, of St. Louis, Missouri.
8. *Entomology, including apiculture and silk culture*—The undersigned, Mr. N. W. McLain, of Hinsdale, Illinois, and Mr. Phillip Walker, of this Department.
9. *Forestry*—Prof. B. E. Fernow, of this Department, and Mr. M. G. Kern, of St. Louis, Missouri.
10. *Sorghum and other sugar plants*—Prof. H. W. Wiley, of this Department.
11. *Grasses and forage plants*—Dr. George Vasey, of this Department.
12. *Meat products*—Dr. D. E. Salmon, of this Department.

In addition to the foregoing divisions of the exhibit the heads of divisions of the Department of Agriculture have been called upon to make contributions in their several specialties as follows:

Methods of collecting and of sending out seeds—Mr. W. M. King.

Mammals and birds injurious or beneficial to agriculture—Dr. C. Hart Merriam.

Illustrations of the principal fungus diseases of agricultural products—Prof. B. T. Galloway.

Illustrations of the methods of discriminating between adulterated and pure food products by microscopic methods—Dr. Thomas Taylor.

General agricultural statistics—Mr. J. R. Dodge.

The attention of all who intend or wish to become contributors to the agricultural exhibit is called to the necessity of putting themselves into communication with this office, either directly by mail, or through the special agents who are already in the field. The time remaining, though ample if exhibitors are prompt in making their purposes known, is yet so short as to leave little margin for delay.

It is intended as far as practicable to show not only the varied products of the country by samples, but also by means of photographs and models, the methods and processes of cultivating, harvesting, and preparing for the market.

While it is the purpose of the Commissioner to make the display one that will be creditable to the country at large, yet the advantages to follow from the spread of information, among foreign peoples, as to the great variety and unrivaled qualities of American agricultural productions, are designed to accrue directly to the individuals and associations who may contribute of their products to the enterprise. The name and locality of the exhibitor will be plainly affixed to every exhibit, and will appear as well in the official catalogues of the Exposition.

Materials contributed in bulk will be placed in suitable receptacles for display, at this office, and all exhibits will be transported to Paris, cared for, and returned free of cost to the exhibitor.

Organizations desiring to prepare, at their own expense, more elaborate exhibits of the products of a given locality should communicate at once the extent of floor or wall space they desire.

All materials designed for the agricultural exhibit must be in Washington not later than the middle of January, 1889, and must be carefully addressed to the undersigned and marked, as must all letters, *Paris Exposition.*

C. V. RILEY,
Representative.

APPENDIX II.

[INSTRUCTIONS TO AGENTS.]

U. S. DEPARTMENT OF AGRICULTURE,
EXHIBIT BY THE COMMISSIONER OF AGRICULTURE,
Washington, D. C., November 14, 1888.

The better to secure coöperation and uniformity in results, and to promote economy both of time and money, special agents are requested to report fully to this office as often as twice each week, stating the localities they have visited and the degree of success with which they are meeting in the work of collecting material for the agricultural exhibit at the Paris Exposition. They are invited to submit freely any suggestions growing out of their experience in the field which may seem to them worthy of attention, and they will keep this office fully informed of their plans and contemplated movements.

The following general rules are formulated for guidance in the work of securing and preparing materials for the exhibit:

1. Each crop or product is to be illustrated as far as possible in all phases—methods of culture, methods of harvesting, of preparing for the market, and ultimate products.

2. Where the actual article can be obtained for exhibit samples should be prepared in neat packages, and where it is of a perishable nature, illustrations should be obtained.

3. Photographs of methods of handling or of manufacture, of harvesting or of cultivating, or of processes which cannot be shown by specimens or models are desirable.

4. All photographs are to be taken in duplicate on 5x8 plates, if practicable, and the negatives must be sharp and clean. The negatives with the proof thereof are to be sent to Washington.

5. All material collected in whatever part of the country is to be shipped in some safe and secure way to Washington where it will be prepared for exhibition and repacked.

6. All material that is to be exhibited should be prepared as early as possible this autumn.

7. Samples of the chief soils upon which particular crops do best may be collected where practicable, and shipped in tin tubes showing depth of supersoil and subsoil.

8. One of the most important duties of each agent will be to prepare an amplified catalogue or report of the exhibit with which he is charged. This should give all information as to the history, geographical distribution, methods of cultivation, harvesting and utilizing the crop, and all other information of a scientific or statistical nature that will prove instructive in the general report of the exhibition which the Commissioner is to print. This amplified catalogue must particularly cover statistics as to amount produced and the money value of each product.

9. Each agent will keep an accurate account of expenses and obtain subvouchers wherever possible, to be used in making up weekly or monthly accounts. Blank subvouchers as well as vouchers for expenses will be furnished by the Department. Salary accounts should be kept separate from expense accounts. All accounts to be made in duplicate and receipted in advance in accordance with the rules of the Government. Fuller details as to rules governing expenses will be furnished.

10. Each agent will be furnished with stationery and penalty envelopes. All communications as to further details of information should be addressed to the Commissioner of Agriculture, or to the undersigned, and the envelope marked *Paris Exposition.*

C. V. RILEY,
Representative.

APPENDIX III.

[AGRICULTURAL EDUCATION.]

U. S. DEPARTMENT OF AGRICULTURE,
EXHIBIT BY THE COMMISSIONER OF AGRICULTURE,
Washington, D. C., 1888.

DEAR SIR: The exhibit which the United States Department of Agriculture is preparing for the International Exposition in Paris, in 1889, is to include materials to set forth the history, status, work, and tendencies of agricultural education and agricultural science in the United States. For this purpose, printed statements, diagrams, pictures, and other illustrative matter concerning agricultural schools, experiment stations, and other like institutions, are desired. To this end you will kindly fill out the inclosed blank* with data regarding your own institution, and return it to the Department in the inclosed envelope at your earliest convenience.

The Commissioner of Agriculture has appointed me to take charge of the exhibit to be prepared by him and to represent him in all matters pertaining thereto; and Prof. W. O. Atwater has been charged with this educational division. I would beg you to help to make this part of the exhibit worthy of your institution, and send to the Department by express, or otherwise, at its expense, catalogues, reports, and other publications, which will explain in detail the facts summarized in the blank form, in order that they may be used wholly or in part for the exhibit at Paris. By doing so you will greatly oblige,

Yours respectfully,

C. V. RILEY,
Representative.

APPENDIX IV.

DETAILED LIST OF THE EXHIBITS FROM THE UNITED STATES.

DIVISION 1.—ANIMAL PRODUCTS.

SECTION I.—MEAT AND DAIRY PRODUCTS.†

[Department of Agriculture, Washington, District of Columbia.]

1. Cold storage refrigerator for showing meats and dairy products.
2. Model showing construction and operation of a creamery.
3. Model showing construction of silo.
4. Refrigerator car for transporting dressed beef.
5. Model of improved car for transporting live stock.
6. Cheese made in the United States suitable for export.
7. Butter made in the United States suitable for export.
8. Set of photographs illustrating types of animals in the United States.

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* The blank contained the following questions:
(1) Name of institution. (2) Date of organization and authority under which it was organized—State or national. (3) Number and constitution of faculty; past and present. (4) Number of students; past and present. (5) Courses of study. (6) Methods of instruction. (7) Equipment and appliances for instruction. (8) Revenue; sources and amounts. (9) General statements regarding history, organization, work, progress, and tendencies of the institution.

† This list is incomplete, as it does not include the packed and cured meats which were sent over after the refrigerator was completed, and which were renewed from time to time.

9. Set of photographs illustrating the methods of handling and slaughtering animals; price chart of mess pork, 1825–'88; price chart of mess beef, 1825–'88; price chart of mess ham, 1825–'88; price chart of mess butter, 1825–'88; price chart of mess cheese, 1825–'88; price chart of mess lard, 1825–'88; chart showing number of cattle on farms 1840, 1850, 1860, 1870, 1880–'88; chart showing number of hogs on farms, 1860; chart showing number of horses and mules on farms, 1860; chart showing number of sheep on farms, 1860; maps showing distribution of cattle on farms; maps showing distribution of hogs on farms; charts showing production of special animal products; charts showing composition of American and European beef.

CANNED GOODS.

[Armour & Co., Chicago, Illinois.]

Ham, luncheon meat, corned beef, brawn, minced steak, Bologna sausage (large), Bologna sausage (small), roast beef, boiled beef, lunch tongue, chipped beef, stewed kidneys, potted beef, potted ham, potted tongue, deviled ham, Oxford sausage, corned beef (rognon cans), breakfast bacon (large), breakfast bacon (small), ox tongues, ox tongues smoked, lunch tongues, minced beef, corned beef.

[Curtice Bros. Co., Rochester, New York.]

Potted chicken, potted turkey, potted ham, potted tongue, potted game, boned turkey, boned chicken, boned ham, boned tongue, roast chicken, roast turkey, rolled ox tongue.

[E. T. Cowdry & Co., Boston, Massachusetts.]

Deviled ham, deviled tongue, deviled turkey, deviled chicken, dried beef, boned chicken, boned turkey.

[Richardson & Robbins, Dover, Delaware.]

Boneless cooked ham, rolled ox tongue, lunch tongue and ham, boned turkey and chicken, curried fowl, potted ham, potted beef, potted tongue, potted turkey, potted chicken, potted duck, potted ham and turkey, potted game.

[Fairbank Canning Co., Chicago, Illinois.]

Minced steak, minced collops, roast mutton, fine family beef, family roast, family flat roast, potted tongues, potted ham, deviled ham, potted tongue, chipped beef, ox tongue, family corned beef, family corned canned beef, lunch tongue, ox tongue, family corned beef, family H. beef, family B. beef, fine B. beef.

[George Brougham, Chicago, Illinois.]

Potted ham, potted chicken, potted boneless turkey, potted boneless chicken, fresh boiled beef, roast beef, corned beef, lunch tongue, chili con carne, ox tongue, chipped beef.

SECTION II.—ECONOMIC ENTOMOLOGY.

SUBSECTION A.—*Apiculture.*

1 and 2. Anatomical charts, illustrating the anatomical structure and physiological developments of the hive bee and its relation to flowering plants.
3. The Falcon Hive, complete, with air-tight chambers and two Falcon section supers, with closed ends and separators, metal-cornered comb frames, chaff division boards, gable cover.
4. The Demaree-Langstroth Hive, complete, for comb and extracted honey; Langstroth frames and closed top, double top-bars, slotted and zinced; slat and zinc honey-board, queen-excluding shallow extracting super, and T-tin reversible super, with half bee-spaces, sections and cleated cover.
5. The Story-and-a-half Simplicity Hive, complete, with metal-cornered brood-frames, slat, wood, and zinc queen-excluding honey-board, T-tin supers, with sections and zinc-hemmed oilcloth super cover.
6. The Hubbard Hive, complete, with section super and sections, self-adjusting brood-frames and slat honey-boards.
7. The Armstrong Hive, complete, for comb-honey, with reversible brood-chamber and reversible T-tin section super and sections, with wood separators, adapted with half bee-spaces for tiering up.
8. The Nonpareil Hive, complete; slat, wood, and zinc queen-excluding honey brood, with Nonpareil section super, with four-piece white poplar sections, adjustable and side opening, and Nonpareil extracting super adapted to tiering up, and double ventilated zinc and wood hive cover.
9. Two-story Simplicity Hive, complete, for comb-honey, with T-tin supers, metal-cornered frames and tin separators and chaff division board.
10. The Heddon Hive, complete, for comb and extracted honey; box bottom-board, divisible brood-chamber, with closed and wired comb-frames, screw-clamped; slat, wood, and zinc queen-excluding honey guards; Heddon reversible section case, with sections and separators, with half bee-spaces adapted to tiering up; and cleated hive cover.

11. The Chautauqua Hive, complete, for comb and extracted honey; double-walled air-tight brood-chamber, metal rabbets, metal-cornered and reversible brood-frames; Chautauqua double and extracting super, with Hoffman frames, adapted to tiering up, with two Chautauqua sections with closed and wide frames, with separators and one-piece sections, oilcloth cover, grooved bottom-board and gable cover.
12. The Simplicity Chaff Hive, with chaff-filled side walls, chaff division boards, metal rabbets, metal-cornered and reversible comb-frames wired, slat, wood, and zinc queen excluding honey-board. T-tin section supers with sections and tin separators and ventilated zinc top gable cover.
13. The Dadant Hive for producing extracted honey, hinged alighting board, Quinby wired frames for brood-chambers, Dadant extracting supers and straw mat for winter.
15. The Given Foundation Machine for pressing sheets of wax for comb-foundation.
16. Stanley's Automatic Four-Frame Honey-Extractor, for extracting honey from the honey-combs. After the cappings are removed the combs are placed in the comb-baskets and rapidly revolved, expelling the nectar. The comb-baskets are automatically reversed and the honey is expelled from both sides of the comb without removal. With this machine it is possible to extract eight or nine thousand pounds of honey in a single day.
17. The Dadant Uncapping Can, with comb-rack and cloth honey strainer and wire bottom wax-pan and honey reservoir with honey gate.
18. The Murphy Two-Frame Honey-Extractor, made with black walnut frame and sheet copper barrel and brass honey-gate.
19. Charles F. Muth's Two-Frame Honey-Extractor, with honey reservoir and honey-gate.
20. Kemp's Two-Frame Excelsior Extractor, manufactured by W. C. R. Kemp.
21. A Queen Incubator, with water-chamber for incubating queen-bee cells.
22. The Vandervort Foundation Mill, for making honey-comb foundation from sheets of beeswax. Comb-foundation is extensively used by all progressive bee-keepers in the United States and many factories in many parts of the United States are employed in the manufacture of wax into comb-foundation. The largest output of comb-foundation from any one factory in the world is from the factory of Charles Dadant & Son, of Hamilton, Illinois. They manufacture and sell from their factory, at wholesale and retail, about 50,000 lbs. of comb-foundation per annum. The Messrs. Dadant use the Vandervort Foundation Mill.
23. Comb-foundation mill made by A. I. Root, Medina, Ohio. Mr. Root is an extensive manufacturer and dealer in comb-foundation.
24. The Pelham Foundation Mill.
25. The Excelsior Wax-Extractor for extracting wax from honey-comb. The Excelsior is made by Messrs. T. G. Newman & Son, Chicago, Illinois.
26. Muth's Wax-Extractor, made by C. F. Muth, Cincinnati, Ohio.
27, 28, and 29. Three Frames of Samples of Comb-Foundation of different weight and thickness for use in different ways and for different purposes. Some suitable to brood-combs and some for use in sections. Manufactured by Charles Dadant & Son, Hamilton, Illinois.
30. A Comb-Bucket for carrying combs.
31. A Comb-Bucket for carrying combs.
32. Samples of Gray's Foundation Fastener.
33. Fastener for fastening comb-foundation in honey sections.
34 and 35. Observatory Hives for observing the habits and working of hive bees.
36. One Full Sheet of Queen-Excluding Zinc of the "Falcon brand," used for making queen-excluding honey-boards, drone traps, etc.
37 and 38. Broken Comb-Baskets, used in extracting honey from broken combs, and also from unfinished honey sections
39. A Nest of Honey Pails, with covers and labels, used in marketing extracted honey.
40. A Pair of Rubber Gloves, used as a protection from stings when working among and manipulating live bees.
41, 42, and 43. Provisioned Wire-Covered Shipping Cages for shipping half-pound, 1 pound, and 1½ pounds of live bees by express.
44. A Black Walnut Show Case, with a glazed sash-cover, hinged and locked, for exhibiting 5 kinds of honey candy and 3 kinds of honey cake in lace-lined boxes.
45. A Model of a House Apiary.
46. Eaton's Improved Section Case, with adjustable side, with the separators and sections, with comb foundation.
47. The Nonpareil Section Super, with adjustable side, 4 piece sections and separators.
48. Bettsinger's Section Case, with woven wire separators, open side sections, and metal section rests.
49. The Falconer Adjustable Partition.
50. The Hoffman Partition-Board.
51. A Nest of Five Raised Cover Novelty Pails; 5 sizes, for marketing extracted honey.
52. A Nest of Five Jones' Raised-Cover Honey Pails.
53. Bittenbender's Brood-Comb Foundation Fastener.
54. Newcomb's Surplus Case, with wide frames and sections.
55. A. J. Cook's Adjustable Partition, with Bee-Feeder.
56. A Swarming Box for Hiving Swarms.
57. Demaree's Bee-Escape. for getting bees out of surplus cases.
58. A Perforated Tin Bee-Feeder, for partition.
59. Wakeman & Crocker's Honey-Section Clamp, for putting together honey sections.
60. The Jones Honey Knife.
61. The Bingham and Hetherington Honey Knife.
62. The Muth Honey Knife.
63. The Carlin Steel Wheel Foundation Cutter for cutting comb-foundation different sizes.
64. Tin Wire Imbedders for fastening the comb-foundation to wires in comb frames.
65. The Roland Foundation Imbedder.
66. The Blood Rollers for fastening foundation to the wires in comb frames.
67. The Bittenbender Foundation Fastener for fastening foundation in honey sections.
68. Comb Foundation Fastener for sections.
69. Shirley's Foundation Fastener.
70. Root's Foundation Fastener.
71, 72, 73, 74, and 75. Samples of Queen Excluding Zinc Honey-Boards; some are flat-rimmed and some are [illegible]nc-rimmed.
76, 77, and 78. Samples of Two-Rowed Zinc Queen Excluding Honey-Boards, with wood rims and with bee space.
79 and 80. Zinc and Slat Honey-Boards with bee space, queen-excluding.
81 and 82. Tinker's Wood and Zinc Excluding Honey-Board, with rim and bee space.
83. A Wood-slat Honey-Board.
84. Samples of Metal-cornered Wired Frames.

85. Indestructible and Reversible metal-cornered and wired comb-frames.
86. Standard Langstroth Brood-Frames.
87. Samples of Hill's device for placing over the comb-frames to make a passage way for the bees under the covering in winter.
88. Samples of Comb-Holders.
89. Model of a Bee-Escape for fitting in the window in a honey room.
90. Muth's Cold Blast Bee-Smoker, No. 1.
91. Muth's Cold Blast Bee-Smoker, No. 2.
92. A. I. Root's Cold Blast Bee-Smoker.
93. Hastings's Perfection Bee Feeder.
94. The Mason Wire-Covered Twin Bee-Feeder.
95. The Falconer Twin Bee-Feeder.
96. Gray's Covered Entrance-Feeders.
97. Heddon's Bee-Feeder.
98. Bridges's Bee-Feeder.
99. Shuck's Entrance Bee-Feeder.
100. Three Samples of Simplicity Entrance Feeders as made by Falconer, Newcomb, and Root.
101. Samples of Locke's perfection bee-feeder.
102. Gray's covered bee-entrance feeder, by Newcomb.
103. Knickerbocker's nucleus hive with feeder, used in queen rearing.
104. Samples of Jones's screw-top tin cans.
105. A bee-hunting box.
106. A primary furnace used in melting wax and rosin when fastening comb foundation.
107. Sheets of queen-excluding perforated zinc, Tinker's pattern.
108. Mason jar atmospheric bee-feeder.
109. Samples of wide frames for sections with honey sections and tin separators.
110. The Falconer-Gray entrance bee-feeder.
111. The Kemp bee-smoker.
112. The Quinby bee-smoker. (Two samples.)
113. The Bingham bee-smoker. (1.)
114. The Bingham bee-smoker. (2.)
115. The Bingham bee-smoker. (3.)
116, 117, 118, and 119. Samples of drone traps as made by H. Alley, Newcomb, Tinker, Root, etc. The drone trap is used to prevent the flight of queens and drone bees, but does not hinder the entrance or exit of the worker bees.
120. Samples of Ackerman's hive-clamps.
121. Scovell's twin bee-feeder.
122. J. B. Mason's section case.
123. Dadant's straw mat for winter use.
124. Newcomb's chaff cushion for winter use.
125. Hilton's section crate for retailing honey.
126*a*. A glass-covered case filled with cakes.
126. Honey jumbles. Manufactured in Ohio.
127. Root's shipping and retailing crate filled with sections in paper cartons.
128. Falconer's single-tier shipping crate.
129. Falconer's 12-pound shipping crate.
130. Newcomb's 12-pound shipping crate.
131. Seven-sections-to-one-foot shipping crate.
132 and 133. Newcomb's standard shipping crate.
134. Lewis' standard shipping crate.
135 and 136. Samples of Mrs. Hill's 8-pound retailing crate.
137. Falconer's three-section front case with cartons.
138. Tinker's 14-pound single-tier, seven to the foot, shipping crate.
139, 140, 141, and 142. Samples of comb foundation; four different kinds, framed and glassed. (Root.)
143. A box containing light and extra light foundation.
144. A box containing light and heavy brood-comb foundation from A. I. Root's factory.
145. A package, containing a full line of samples of comb-foundation of all different weights and kinds, from Dadant & Son.
146. A package, containing light and heavy comb-foundation, from William Cary, Coleraine, Mass.
147. Package of sample copies of American Bee Journal.
148. Smith's queen nursery.
149. Van Deusen hive-clamps. (Adjusted.)
150. Holden's patent pocket mosquito bar.
151, 152, and 153. Samples of bee veils.
154. Samples of Jones' bee entrance guards.
155. A cloth cover for honey extractor.
156. Samples of perforated zinc strips and wood slats for queen-excluding honey-boards.
157, 158, and 159. Samples of perforated zinc for drone traps.
160. A package of record slates for hives.
161. Jones' frame pliers.
162. Package of hive-clamps
163. Five samples bee-brushes. (Fiber.)
164. Three samples bee-brushes. (Yucca.)
165. Samples of Klimitz queen cages, as made by Falconer, Root, Newcomb, etc.
166. Samples of the Peet queen cage, for shipping and introducing live queen bees, as made by Root, Falconer, Newcomb, etc.
167. Demaree's shipping cage for queen bees.
168. Demaree's queen cage for use in apiary.
168½. Morrison's mailing and introducing cage.
169. Tinker's mailing cage for queen bees.
170. Petty's mailing cage for queen bees.
171. Alley's mailing cage for queen bees.
172. Muth's introducing queen cage.
173. Comb-clasps for transferring combs.
174. Five hundred 1 piece V-groove sections, original package from W. T. Falconer.
175. Five hundred 1-piece V-groove sections, original package from G. B. Lewis & Co.
176. An improved Barnes foot-power band and circular saw, from the Barnes Manufacturing Co., Rockford, Illinois.
177. A case of honey confections.
178. Ten ½-pound screw-top glass honey-pails.

179. Ten 1-pound screw-top glass honey-pails.
180. Ten 1½-pound screw-top glass honey-pails.
181. One 2-pound and 1 5-pound Jones honey-pails, screw top.
182. One 1-pound, 1 2½-pound and 1 5-pound Jones honey-pails.
183. One 5-pound pail of honey. Spanish needle, from Dadant & Son, Hamilton, Illinois.
184. One 1-pound jar three-year old clover honey.
185. One 2-pound jar, three-year old clover honey, from G. W. Demaree, Kentucky.
186. A package of bee-balm honey, *Melissa officinalis*, from A. C. Tyrrel.
187. A jar of horehound honey.
188. A jar of horsemint honey.
189. A jar of silver weed honey.
190. A jar of red daisy honey.
191. Two dozen jars of white clover honey.
192. Two dozen jars of white clover honey.
193. A 14-pound crate of linden honey. (Sections.)
194. A 14-pound crate of linden honey. (Sections.)
195. A 24-pound crate of cucumber honey. (Sections.)
196. A jar of cucumber honey. (Extracted.)
197. A package of saw palmetto honey. (Extracted.)
198. A package of mangrove honey. (Extracted.)
199. A package of white sage honey. (Extracted.)
200. A package of honey-wine.
201. A package of honey vinegar.
202. A package containing a complete line of samples of flat-bottomed comb-foundation, manufactured by James Van Deusen & Sons, Sprout Brook, New York.
203. Frames of flat-bottomed comb-foundation of different weights for honey sections and for brood combs, framed and under glass, manufactured by James Van Deusen & Sons, Sprout Brook, New York.
204. A package of Van Deusen hive clamps.
205. A package of section cartons.
206. Reeses' wide-entrance drone trap.
207. Reeses' two-cone bee escape for getting the bees out of surplus cases.
208. Prof. A. J. Cook's bee-tongue meter.
209. William Muth-Rassmusen's frame-hook and spring.

Silk culture.

1. Sixty-four specimens of cocoons raised in the United States, including several specimens of a cross-bred race, raised without outcrossing for 18 years on mulberry and *Maclura Aurantiaca.*
2. Design in silk woven in the filature of the Department of Agriculture at Washington.
3. Automatic reel on the Serrell system with modifications invented by Mr. Philip Walker, Superintendent Silk Division, Department of Agriculture.
4. Objects employed by the Department of Agriculture of the United States in the distribution of the silk worm eggs.
5. Twelve hundred Engravings and drawings illustrating insect life in the United States from the original collection and drawings made by Prof. C. V. Riley, Department of Agriculture, Washington, D. C.

Subsection C.—Insects injurious and beneficial.

Insects affecting the apple (exhibits 1 to 34).
Insects affecting the pear (exhibits 35 to 40).
Insects affecting the peach (exhibits 41 to 49).
Insects affecting the orange (exhibits 50 to 84).
Insects affecting the strawberry (exhibits 85 to 95).
Insects affecting the raspberry (exhibits 96 to 104).
Insects affecting the currant (exhibits 105 to 108).
Insects affecting the gooseberry (exhibits 109 to 111).
Insects affecting the melon (exhibits 112 to 118).
Insects affecting the cranberry (exhibits 119 to 126).
Insects affecting the persimmon (exhibits 127 to 131).
Insects affecting the grape vine (exhibits 132 to 174).
Insects affecting sugar cane (exhibits 175 to 176).
Insects affecting hops (exhibits 177 to 181).
Insects affecting rice (exhibits 182 to 185).
Insects affecting Indian corn (exhibits 186 to 206).
Insects affecting small grains (exhibits 207 to 236).
Insects affecting cotton (exhibits 237 to 257).
Insects affecting grass (exhibits 250 to 276).
Insects affecting clover (exhibits 277 to 295).
Insects affecting the pea (exhibit 296).
Insects affecting the cabbage and cauliflower (exhibits 302 to 317).
Insects affecting the sweet potato (exhibits 310 to 324).
Insects affecting the potato (exhibits 325 to 335).
Insects affecting the tomato (exhibits 336 to 339).
Insects affecting tobacco (exhibits 340 to 342).
Insects affecting asparagus (exhibit 343).
Insects affecting the onion (exhibits 344 to 345).
Insects affecting stock (exhibits 346 to 349).

Insects affecting forest trees.

Affecting the locust tree (exhibits 350 to 355, inclusive).
Affecting conifers (exhibits 356 to 371, inclusive).
Affecting the tulip tree (exhibits 372 to 373, inclusive).
Affecting the Tree of Heaven (exhibit 374).
Affecting the hackberry (exhibits 375 to 381, inclusive).

Affecting the pine (exhibits 382 to 418, inclusive).
Affecting the linden (exhibits 419 to 428, inclusive).
Affecting the wild cherry (exhibits 429 to 434, inclusive).
Affecting the ash (exhibits 435 to 437, inclusive).
Affecting the sweet gum (exhibits 438 to 439, inclusive).
Affecting the persimmon (exhibits 440 to 441, inclusive).
Affecting the alder (exhibits 442 to 443, inclusive).
Affecting the mesquite (exhibit 444).
Affecting the June or service berry (exhibit 445).
Affecting the paper mulberry (exhibit 446).
Affecting the elm (exhibits 447 to 455).
Affecting the maple (exhibits 456 to 462).
Affecting the hickory (exhibits 463 to 480).
Affecting the oak (exhibits 481 to 573).
Affecting the *Sequoia gigantea*.
Affecting poplar and cottonwood (exhibits 574 to 581).
Affecting the willow (exhibits 582 to 609).

Subsection D.—Insecticides.

Insecticides of leading importance are shown in this collection. The method in which each one is mixed or applied is generally stated under its name.

1. *Acetic acid.*—In dilution to about 10 to 15 per cent of the acid. It is applied as a spray.

Arsenical mixtures.—For fuller particulars see Bull. 3, U. S. Ent. Comm. on the Cotton Worm; the Report of the Department on the same subject, and the Reports of the Entomologist since 1878.

2. *Arsenic.*—The white arsenic as a powder is mixed in baits for destroying insects. It is also used on field crops. To 20 pounds of flour one-half pound of arsenic is added and thoroughly mixed. This is then applied by a sifter or blower. A solution of 8 ounces in 40 to 80 gallons of water may be sprayed.

Arsenic scalds the plants to such an extent that one of the two following is generally preferred:

3. *London purple.*—To 20 pounds flour ¼ to ½ pound is added and well mixed. This is applied by a sifter or blower. With 40 gallons water ¼ to ½ pound is mixed for spraying.

4. *Paris green.*—With 20 pounds flour ¾ to 1 pound is mixed and applied by sifting or by a blower. The same amount to 40 gallons water is used as a spray.

5. *Paris green, adulterated.*—This is to be avoided. It is quite commonly sold by the trade. Its color is generally lighter than pure green.

6. *Ashes.*—Wood ashes sifted on or placed around the bases of plants.

7. *Benzine.*—This is used in cabinets or confined with household goods. Enough is applied to make its odor as strong as possible.

8. *Bisulphide of carbon.*—For use in the ground a quantity is poured or injected among roots that are being injured. Against insects injuring stored grain or museum material a small quantity is used in an air-tight vessel.

9. *Borax.*—The powder or a strong solution is applied in crevices or on surfaces frequented by roaches, etc., to drive them away.

10. *Camphor.*—As a preventive this is confined in drawers and packages to protect dry goods and specimens.

11. *Carbolic acid.*—A solution of 1 part in 100 of water is used against parasites on domestic animals and in their houses; also on the surface of plants and among roots in the ground.

12. *Coal tar.*—Painted on tree trunks, etc., to catch or prevent insects from mounting. By a few quarts in a barrel of water a solution is made to sprinkle plants as a preventive. In 1 gallon of water 1 quart is dissolved (with heat) to form a stronger solution for use in the ground among roots and on the foliage. The smoke from burning coal tar is used as a repellant.

13. *Copperas.*—In 1 barrel of water 5 pounds are dissolved as a solution to sprinkle on plants.

14. *Creosote.*—Used like carbolic acid.

15. *Hellebore.*—The powder is sifted on alone, or mixed 1 part to 20 of flour. With 1 gallon water ½ pound is mixed, as a liquid to be sprayed.

16. *Lime.*—The dry lime is sifted on, or, as whitewash, is applied by a brush.

17. *Lye.*—In 1 gallon water 1 pound of concentrated lye is dissolved as a solution to spray on trees.

18. *Naphthaline.*—Used in the ground around roots that are attacked by insects and in cabinets to prevent pests.

19. *Oil of cotton.*—Rubbed on domestic animals against parasites.

20. *Oil of turpentine.*—Applied on the bark of trees and on live stock suffering from parasites.

21. *Petroleum, crude.*

22. *Petroleum, refined.*—Of the crude or refined 2 tablespoonfuls in a bucket of water are mixed and constantly stirred while being sprayed.

23. *Petroleum, milk emulsion.*—To 1 part milk add 2 parts of kerosene and churn by a force pump or other agitator. The butter-like emulsion is diluted *ad libitum* with water. For fuller particulars see late reports and bulletins of the entomologist.

24. *Petroleum, soap emulsion.*—In 1 gallon hot water ½ pound of whale-oil soap is dissolved. This, instead of milk, is mixed to an emulsion with kerosene, in the same manner and proportions as just stated.

25. *California Buhach* (*Pyrethrum flowers, Dalmatian, open*).—From these the Buhach of Mr. N. G. Milco, Stockton, California, and the Dalmatian insect powders are made. Species, *P. cinerariæfolium*.

26. *Pyrethrum flowers* (Dalmatian, one-half open).

27. *Pyrethrum flowers* (Dalmatian; closed).

28. *Pyrethrum* (*powder of the flowers, Dalmatian*).—*P. cinerariæfolium or California Buhach powder.*—This is blown or sifted on dry, also applied in water, 1 gallon to a tablespoonful of the powder, well stirred and then sprayed.

29. *Pyrethrum flowers* (*Persian*).—From these the Persian powder is derived; species *P. roseum*.

30. *Pyrethrum* (*powder of the flowers, Persian*).—*P. roseum*, or Persian insect powder; used as just stated above.

31. *Salt, common.*—A strong solution is sometimes used as a spray; more often applied in crystal to the ground as a preventive dressing.

32. *Saltpeter.*—Used the same.

33. *Soft soap.*—This is rubbed on the trunks of trees to protect them from or to kill insects.

34. *Soap, common bar.*—Used the same as 33 and as suds.

35. *Soap, whale oil.*—Used the same as 33, but better.

36. *Solution of soap.*—A strong solution of either of the soaps; employed as a wash or spray for preventing or destroying soft-bodied insects.
37. *Sulphur powder.*—Sifted or blown into plants. The smoke is also used to fumigate.
38. *Sulphocarbonate of potassium.*—Applied in holes or trenches to destroy root-feeding insects like the Grape *Phylloxera.*
39. *Quassia.*—A strong decoction is used against soft-bodied insects.
40. *Tobacco, decoction.*—This is made as strong as possible as a wash or spray to kill insect pests on animals or plants.

Subsection E.—Insecticide appliances.

Spray pumps.—For applying poison solutions to destroy insects.
Syringes, hydronettes, etc.—These are worked between the two hands, are light, easily directed, and may be used from a wagon, on horseback, or while standing.
1. Syringe No. 4. Robert T. Deakin & Co., Philadelphia, Pennsylvania.
2. Syringe No. 5. Robert T. Deakin & Co., Philadelphia, Pennsylvania.
3. Syringe No. 6. Robert T. Deakin & Co., Philadelphia, Pennsylvania.
4. Syringe sprayer. P. C. Lewis, Catskill, New York. A brass spray-syringe with rubber piston-head.
5. Hydronette. R. T. Deakin, Philadelphia, Pennsylvania.
6. Hydronette. Rumsey & Co., Seneca Falls, New York.
7. Hydronette. W. & B. Douglas, Middletown, Connecticut.
The above three pumps are all double-acting and throw a constant spray.
8. Fountain pump. J. A. Whitman, Providence, Rhode Island. A single-acting pump and throws the spray by interrupted spurts. *Aquapults, etc.* These are light double-acting pumps used with one end supported in a vessel or on the ground. They may be worked in a wagon or while standing, but not while walking. They discharge near the top from the cylinder.
9. Johnson's aquapult. W. J. Johnson, Newton, Massachusetts; National Manufacturing Company, Boston, Massachusetts; Rumsey & Co, Seneca Falls, New York; W. & B. Douglas, Middletown, Connecticut.
10. Prouty's aquapult. A. B. Prouty, Worcester, Massachusetts; New England Butt Company, Providence, Rhode Island. This has a peculiar packing and longer leg than the foregoing styles.
11. Excelsior pump. R. T. Deakin, Philadelphia, Pennsylvania. A pump similar to the aquapults and subserving the same purposes.
12. Aquaject. Rumsey & Co., Seneca Falls, New York. A double-acting air-chambered pump.
13. Hydropult. W. T. Vose, Newtonville, Massachusetts. A double-cylindered, double-acting, air-chambered pump, used like the aquaject.
Bucket pumps.—These are light pumps, which discharge from near the base of the cylinder. They are single-acting, used like the aquapults, but mostly less satisfactory.
14. Combination pump. P. C. Lewis, Catskill, New York. A brass pump with rubber piston-head.
15. Evenden's pump. J. G. Evenden, Chicago, Illinois. A cheap, air-chambered, double-walled, tin pump, fixed in a can.
16. Aquarius. W. & B. Douglas, Middletown, Connecticut. A brass bucket-pump that will stand long service. It is air-chambered with a top discharge.
17. Climax pump. A. H. Nixon, Dayton, Ohio.
Barrel and tank pumps.—These are worked, attached to a barrel or tank, on a wagon or other means of conveyance.
18. Model stirrer-pump, with under spraying devices. Bureau of Entomology, Department of Agriculture, Washington, District of Columbia. Illustrating its use in poisoning the underside of leaves. A double-acting pump inserted in the side bung of a barrel and having a rocking motion by which a stirrer, on its base in the barrel, is moved back and forth to keep the poison mixed.
19. Garden or greenhouse engine. W. & B. Douglas, Middletown, Connecticut. A bucket pump similar to 16, fitted into a small tank mounted on wheels.
20. Garden pump. Rumsey & Co., Seneca Falls, New York. A large pump for garden work, tripod-mounted, and worked by means of a fly-wheel handle.
21. Schier's tin pump. John Schier, Ellinger, Texas. Inserted in a large can and bears (1) his return-drip device for saving the poison, and (2) his broadcast spray-nozzle.
Centrifugal throwers.—These impart a centrifugal force to the poison and thus scatter it into a spray.
22. Rotary-brush thrower of insect-powder. Bureau of Entomology, Department of Agriculture, Washington, District of Columbia.
Rotary blowers of poison.—Those here shown are of small size, to be worked suspended on one side or in the hands of a person.
23. Front-discharge rotary powder-blower. Bureau of Entomology, Department of Agriculture, Washington, District of Columbia.
24. Powder gun for low work. Legget & Bro., New York.
25. Powder gun with extension barrel. Legget & Bro., New York.
26. Rotary blower of liquid. Bureau of Entomology, Department of Agriculture, Washington, District of Columbia.
Oscillating blowers of poison.—Under this heading are shown two small bellows blowers, worked suspended from the shoulder or carried in the hands.
27. Metallic bellows blower, front-handled, with suspended side can and under pipe. Bureau of Entomology, Department of Agriculture, Washington, District of Columbia.
28. Metallic bellows blower, rear-acting, front-handled. Bureau of Entomology, Department of Agriculture, Washington, District of Columbia. To use with back-can feeder (48-pound) and under fork.
29. Powder-blower, double-cone form. T. K. Woodason, Chicago, Illinois.
30. Powder blower, single-cone form T. K. Woodason, Chicago, Illinois.
31. The Favorite. California Bellows Manufacturing Company, San Francisco, California.
32. Nether-chamber blast-atomizer, with mouth-pipe. For spraying the under surfaces of plants.
33. Bellows atomizer, large size. T. K. Woodason, Chicago, Illinois.
Gravitational distributors of poison.—In the devices of this section the force of gravitation causes the poison to fall finely from a sifter or sprinkler.
34. Powder-duster, B. F. Hammond, Fishkill, New York.
35. Powder-duster, B. F. Hammond, Fishkill, New York.
36. Powder-duster, with side handle. B. F. Hammond, Fishkill, New York.
37. Etna dusting can. B & J. W. Belcher, Chicopee Falls, Massachusetts.
38. Handled sifter. A common, very efficient little sifter for applying Paris green or London purple on the cotton or potato crops.
39. Knapsack poison distributor, with stop-valve, flexible nozzle-pipe, and agitator. G. W. Townsend, Greenville, New York. Working the handle of the stirrer keeps the poison mixture from separating. The small hand lever opens a valve. By this the liquid is made to flow or stop at will.

40. Base-rose sprinkler, with stop-valve. W. B. Allen, Orleans, New York. Very convenient to use instead of watering-pots.
41. Bamboo hose extension pipe, jointed and fitted with hose and Riley nozzle.
42. Bamboo hose extension pipe; short form, with hose and nozzle clamps.

Nozzles.—For spraying insecticides, showing the leading styles. They are used singly or in groups, combined with force pumps, such as are shown under Nos. 1 to 21.

Many-punctured nozzles.—These have a many-punctured face, by which the liquid is divided into a spray.

43. Foss nozzle (removable-faced rose head). L. B. Foss, Dover Stamping Company, Nos. 88 and 89 N street, and T. O. Metcalf & Co., Milk street, Boston, Massachusetts, manufacturers.
44. Rumsey nozzle (common rose head). Rumsey & Co., Seneca Falls, New York. Used on syringes, hydronettes, etc.
45. Vose nozzle (reversible-faced rose head). W. T. Vose, Newton, Massachusetts.
46. Fox nozzle (fine-spray rose). S. H. Fox, St. Louis, Missouri. A close strainer, inside, keeps particles from clogging the finely-punctured face. By unscrewing the cap it may be cleaned out.

Slot nozzles.—By these the liquid is forced from a narrow slit in a thin sheet, which breaks into a spray.

47. Fowler nozzle (flat-tube slot-nozzle). T. H. Fowler, Oakland, California. Used for spraying to destroy insects on trees, etc., in California.
48. Schier nozzle (single and triple side-slot nozzles). John Schier, Ellinger, Texas. Used on Mr. Schier's spray-pump for poisoning the cotton-worm
49. Melcher nozzle (L-tube and T-tube slot-nozzle). J. C. Melcher, O'Quinn and Black Jack Springs, Texas. Similar to Mr. Schier's.
50. Ruhmann nozzle (adjustable-lip slot-nozzle). J. P. Ruhmann, Schulenburg, Texas. The slot may be lessened or closed by the thumb-screw.
51. Ruhmann nozzle (adjustable-lip slot-nozzle with trigger). J. P. Ruhmann, Schulenburg, Texas.
52. Helmecke nozzle (adjustable-lip direct-discharge slot-nozzle). F. A. Helmecke, Round Top, Fayette County, Texas. Adjusted by the screw on the tip.
53. Pinter nozzle (semiplug slot-nozzle). F. T. Pinter, Schulenburg, Texas. The plug is adjusted and clamped by the eye-screw.
54. Melcher nozzle (milled-plug slot-nozzle). J. C. Melcher, Black Jack Springs post-office, and O'Quinn, Texas. By the string to an internal eye on the plug it is held in place.

Deflector nozzles.—These have an inclined plate by which the jet is spread into a flat spray.

55. Fifield nozzle (deflector-spray and solid-jet hose-nozzle). C. W. Fifield, Lowell, Massachusetts. By screwing the barrel it may be set to throw either a solid jet or a spray.
56. Killam nozzle (side-flanged deflector-nozzle). J. W. Killam, Lake ood, New Jersey. One of the simplest of its class.
57. Campbell nozzle (flanged straight-front deflector-nozzle). John Campbell, Selma, Alabama, and Montgomery, Alabama. Much used for spraying cotton.
58. Schier nozzle (many-jet proximal deflector-nozzle). With air-chamber cap. John Schier, Ellinger, Texas.
59. Schier nozzle (triple-jet direct-reflector nozzle) with screw cap. John Schier, Ellinger, Texas. Two modifications are shown. They are used attached vertically on Mr. Schier's spray pumps.
60. Schier nozzle (convex center, single jet). John Schier, Ellinger, Texas. The medium convexity of this nozzle spreads the water more toward the margins, thus giving a more uniform spray.
61. Lewis nozzle (retractile deflector-nozzle). P. C. Lewis, Catskill, New York. The deflector is slid back when a solid jet is desired.

Spray and jet nozzles.—

62. Nixon nozzle (No. 2). A. H. Nixon, Dayton, Ohio.
63. Nixon nozzle (No. 3). A. H. Nixon, Dayton, Ohio.
64. Nixon nozzle (No. 5). A. H. Nixon, Dayton, Ohio.
65. Nixon nozzle (No. 6). A. H. Nixon, Dayton, Ohio.

The spray is produced in the Nixon nozzles by causing the jet to pass through a screen.

66. San José nozzle. Woodin & Little, San Francisco, California.
67. Universal nozzle.
68. Imperial nozzle. Woodin & Little, San Francisco, California.
69. Colliding jet-nozzle. National Manufacturing Company, Boston, Massachusetts. It produces two jets which collide and dash each other into a spray.
70. Jewell hose-pipe nozzle. Field & Force Pump Company, Lockport, New York.
71. Boss hose-pipe nozzle. Field & Force Pump Company, Lockport, New York.
72. Graduating hose-pipe nozzle. Field & Force Pump Company, Lockport, New York.
73. Crown hose-pipe nozzle. Field and Force Pump Company. Lockport, New York.
74. Hotz nozzle (spray and solid-jet barrel or hose-pipe nozzle), N. Hotz, inventor.
75. Lowell graduating nozzle. C. W. Fifield, Lowell, Massachusetts.
76. Clark nozzle (spray and solid-jet barrel or hose nozzle). W. M. Clark, Newark, New Jersey. By rotation of the perforated sheath it may be set for either spray or solid jet.
77. Gray nozzle (the "Fairy" spray and solid jet). J. W. Gray, Hartford, Connecticut. The shut-off plug can be adjusted to throw a spray or solid jet at will.
78. Spray and solid-jet barrel or hose nozzle, manufactured in Cincinnati, Ohio.

Centrifugal spray nozzles.—These emit the liquid with a whirling motion, which causes it to break into a spray.

Illustrations of the development of the Riley or cyclone nozzle.

79. Riley nozzle (deflector with screw cap). United States Entomologist.
80. Riley nozzle (glass-faced, to show the rotation of the liquid). United States Entomologist.
81. Riley nozzle (large opening; side discharge). United States Entomologist. Gives an extremely large and broad spray.
82. Riley nozzle (flattened tube; side discharge). United States Entomologist.
83. Riley nozzle (side-cone form). United States Entomologist. With a conical chamber a coarser but more extended spray is produced.
84. Riley nozzle (double entrance; side discharge). United States Entomologist.
85. Riley nozzle (side discharge). United States Entomologist.
86. Riley nozzle (side-faced). United States Entomologist.
87. Riley nozzle (oblique-faced; rear discharge). United States Entomologist. Inlet spout inserted at an angle with the face.
88. Riley nozzle (side-faced; large discharge). United States Entomologist.
89. Riley nozzle (concave faces; side discharge). United States Entomologist.
90. Riley nozzle (oblique-faced). United States Entomologist.
91. Riley nozzle (diagonal-faced). United States Entomologist.
92. Riley nozzle (cone chamber; side discharge). United States Entomologist.
93. Riley nozzle (cone chambered). United States Entomologist.

94. Riley nozzle (with rim and side perforations). United States Entomologist. The rotary current of liquid inside lessens the clogging. It has a removable cap and makes a flat spray.
95. Riley nozzle (side slot). United States Entomologist.
96. Riley nozzle (slot-rim nozzle.) United States Entomologist. One face is removable by unscrewing. The discharge slot is from the rim.
97. Riley nozzle (whistle jet). United States Entomologist. The internal colliding of the outgoing and ingoing currents causes the two to cut each other up into a fine spray.
98. Riley nozzle (direct discharge). United States Entomologist.
99. Riley nozzle (screw-cap; direct discharge). United States Entomologist.
100. Riley nozzle (large, direct discharge). United States Entomologist.
101. Riley nozzle (medium; direct discharge). United States Entomologist.
102. Riley nozzle (direct-faced; separable parts). United States Entomologist.
103. Riley nozzle (filled neck, small chamber, large discharge). United States Entomologist.
104. Riley nozzle (beveled-base discharge). United States Entomologist.
105. Riley nozzle (with direct discharge). United States Entomologist.
106. Riley nozzle (large side-faced with removable base). United States Entomologist.
107. Riley nozzle (large side-faced; as nose-piece.) United States Entomologist.
108. Riley nozzle (with handle or leg). United States Entomologist.
109. Riley nozzle (with handle or leg). United States Entomologist.
110. Riley nozzle (cone-chambered; exterior and interior). United States Entomologist.
111. Riley nozzle (standard under-spray, showing its interior). United States Entomologist. It will be noticed that the inlet is from one side of the tube. The chamber has a flat top and base.
112. Riley nozzle (thick lip, small chamber, large discharge). United States Entomologist.
113. Riley nozzle (standard size; side discharge). United States Entomologist.
114. Riley nozzle (side discharge screw stem). United States Entomologist
115. Riley nozzle (standard size; diagonal-faced). United States Entomologist.
116. Riley nozzle (standard size; short insertion stem). United States Entomologist.

DIVISION 2.—FOOD SUBSTANCES OF VEGETABLE ORIGIN.

SECTION III.—CEREAL EXHIBIT.

Subsection A.—Cereals in the ear.

Exhibit 1.—Octagonal case containing 130 specimens of wheat, oats, barley, and rye, duly labeled, contributed by C. E. Thorne, director of the Ohio Agricultural Experiment Station, Columbus, Ohio, and Prof. Luther Foster, of the agricultural college, Brookings, Dakota, and Alex. Shaw, Denver, Colorado.

Sundry specimens of corn (maize) representing all varieties known in the United States.

Exhibit 2.—Six cases (wire screen front and back) containing 226 specimens of maize (including sweet and pop corns) contributed from Vermont, Maryland, Ohio, Massachusetts, Illinois, Iowa, Nebraska, Missouri, Minnesota, and Dakota, duly labeled with name of variety and contributor.

Exhibit 2a.—Sample of corn grown in Northern Dakota.

Exhibit 2b.—Sample of corn grown in New England (Vermont).

Exhibit 3.—Eight large plaques, consisting of handsome designs of the various grains and grasses grown in Colorado. Contributed by Prof. C. L. Ingersoll, president of the agricultural college, Fort Collins, Colorado.

Subsection B.—Cereals in the grain.

Exhibit 4.—Three stands, containing each 84 boxes of hulled grains under glass, duly labeled with name of variety and contributor, and consisting of wheat, maize, oats, barley, rye, buckwheat, dhoura corn, etc.—252 samples in all.

Exhibit 5.—Wheat in sacks, each sack representing one of the grades officially established by the State inspection of Minnesota, contributed by Messrs. C. A. Pillsbury & Co., of Minneapolis.

Exhibit 6.—Grain in sacks and in cases, representing the various grades officially established by the State inspection of Illinois. Contributed by the board of trade of the city of Chicago.

Subsection C.—Farinaceous substances.

Exhibit 7.—Flour in its various processes of manufacture; 40 specimens from the mills of Messrs. C. A. Pillsbury & Co., Minneapolis, Minnesota.

Exhibit 8.—Collection of various kinds of finished cereal products manufactured from maize, wheat, oats, and barley, from the mills of T. Schumacher & Co., Akron, Ohio.

Exhibit 9.—Samples of "Maizena," grape sugar, and glucose, from the Glen Cove Manufacturing Company, New York.

Exhibit 10.—Samples of oil made from the germ of the maize, from J. C. Klanber, Philadelphia, Pennsylvania.

Subsection E.—Miscellaneous articles relating to cereals.

Exhibit 11.—Model of primitive "corn crib," commonly used by the pioneer farmers of the Western States.

Exhibit 12.—Photographs and lithographs representing elevators, mills, and methods of cultivation and transportation of grain.

Subsection G.—Rice.

Exhibit 13.—Rice, the raw finished product, including 16 specimens representing the various processes of the milling, from Col. A. P. Butler, commissioner of agriculture for the State of South Carolina, Columbia, South Carolina.

Special mention should be made, in addition to the parties named above, of the following persons, to whom I am specially indebted for contributions and assistance in getting up the cereal exhibit: Messrs. G. E. Morrow, professor of agriculture, University of Illinois, Champaign, Illinois; Ex-Governor R. W. Furnas, Brownville, Nebraska; Mr. C. C. Whitney, Marshall, Minnesota; Mr. F. I. Whitney, general passenger agent St. Paul, Minneapolis and Manitoba Railroad, St. Paul, Minnesota; Gen. J. S. Black, Washington, District of Columbia; Mr. J. P. Silver, Glenville, Maryland; Mr. J. H. Bretz, Oakdale, Nebraska; Mr. A. F. Haase, Dakota City, Nebraska; Prof. C. H. Bessey, director agricultural experiment station, Lincoln, Nebraska; Prof. W. A. Henry, director agricultural experiment station, Madison, Wisconsin; Mr. I. K. Gwynn, secretary of the Southwestern Missouri Immigration

Society, Clinton, Missouri; Mr. R. H. Vanderhoof, Newton, Illinois; Mr. I. F. Nelson, Olney, Illinois; Mr. J. P. Higgins, Calhoun, Illinois; Mr. C. S. Gabrilson, New Hampton, Iowa; Mr. C. M. Upson, Cummings, Traill County, Dakota; Messrs. Mins Brothers, Emerson, Iowa; and Mr. Frank L. Moffett, St. Paul, Minnesota.

These gentlemen not only contributed ungrudgingly of their own material, but labored diligently and without other reward than the consciousness of serving a good cause, to secure contributions from others and to aid in preparing a creditable cereal exhibit.

As the Commissioner of Agriculture observes in his report of the exhibit as a whole, the lateness of the season when the work was begun and the limited amount of space available for our Department in Paris must be held responsible for some deficiencies in the extent of the cereal exhibit. As to its character it is fully up to the standard of our great reputation as a grain producing country.

SECTION IV.—VEGETABLES.

CANNED VEGETABLES.

Exhibit of F. H. Perry & Co., Providence, Rhode Island: Three cans of tomatoes, (glass); three cans of asparagus, (glass); three cans of beans, (glass); three cans of sweet corn, (glass.)

Exhibit of Kennon, Gray & Co., Sublett Tavern, Virginia: Five cases each of tomatoes and sweet corn in tin.

Exhibit of Thomas J. Myer & Co., Baltimore, Maryland: Six cans of peas in tin; six cans of string beans in tin; six cans of Egyptian sweet corn in tin; six cans of Lima beans in tin; six cans of okra in tin; six cans of gumbo in tin.

Exhibit of W. Munsen & Sons, Baltimore, Maryland: Three cases of tomatoes in tin; three cases of sweet corn in tin.

Exhibit of Winterport Packing Company, Winterport, Maine: Nine cases of sweet corn, Norembega brand, in tin; twelve cans Winterpool sweet brand in tin.

Exhibit of Martin Wagner & Co., Baltimore, Maryland: Six cans of tomatoes in tin.

Exhibit of E. B. Mallory & Co., Baltimore, Maryland: Six cans of tomatoes in tin; six cans of peas in tin; six cans of corn in tin.

Exhibit of F. Clagett, Upper Marlboro, Maryland: Twelve cans of sweet corn in tin; twelve cans of Lima beans in tin.

Exhibit of Griffin Canning Company, Griffin, Georgia: Twenty-four cans of tomatoes in tin.

Exhibit of Sears & Nicholl, Chillicothe, Ohio: Twelve cans of corn.

Exhibit of the Erie Preserving Company, Buffalo, New York: Twenty-four cases of succotash in tin; twenty-four cans sweet corn in tin; twenty-four cans of tomatoes in tin.

Exhibit of A. B. Cleveland & Co., New York: Twenty-nine varieties of peas; twenty-nine varieties of beans; fifteen varieties of sweet corn; eleven bags of beans; ten bags of peas; six bags of corn.

Exhibit of the Joseph Harris Seed Company, Rochester, New York: Twelve varieties of beans; twelve varieties of peas; one variety of beets.

Exhibit of Seed Division, United States Department of Agriculture: Varieties of miscellaneous garden seeds.

Pickles and sauces.

Exhibit of J. & F. Heintz, Pittsburg, Pennsylvania: Four bottles of catsup; four bottles of onion pickles; two bottles of cauliflower; six bottles of mixed pickles; two bottles of Chili sauce; two bottles of celery; two bottles of mustard; one bottle of mustard dressing; three bottles of spiced pickles; two bottles of gherkins; two bottles of sweet pickles.

Hops.

S. Gridley & Co., Waterville, New York: Case of pressed hops; ten samples of hops.
A. W. Mills, Clinton, New York: Four samples of hops.
Anheuser-Busch Brewing Association, St. Louis, Missouri. Four samples of hops.
Robert Quaif, Cooperstown, New York. Six samples of hops.
New York Extract Works, Waterville, New York. One case extract of hops.
Anheuser-Busch Brewing Association, St. Louis, Missouri. Eight cases of beer.
Collection of photographs, hop picking, cranberry sorting, celery fields, etc.

SECTION V.—FRUITS.

Subsection A.

1. Citrus fruits. By Frank A. Kimball, National City, California.
2. Citrus fruits. By Division of Pomology, U. S. Department of Agriculture.
3. Series of models of citrus fruits.

Subsection B.

[Exhibit by the Florida State Horticultural Society.]

1. Sub-tropical fruits.

Subsection C.

[By Division of Pomology, U. S. Department of Agriculture.]

1. Series of models of orchard fruits.

Subsection E.

1. English walnuts. By George F. Hooper, Sonoma, California.
2. Pistachio nuts By G. P. Rixford, San Francisco, California.
3. Pecan nuts. By Arthur Brown, Bagdad, Santa Rosa County, Florida.

Subsection F.

1. Evaporated peaches. By John J. Rosa, Milford, Delaware.
2. Dried prunes. By George F. Hooper, Sonoma, California.
3. Dried grapes. By N. L. Drew, Sacramento, California.
4. Series of dried grapes. By California Dried Fruit Association, San Francisco, California.
5. Dried grapes. By J. H. Wheeler, chief executive officer of the State Viticultural Commission, San Francisco, California.
6. Series of dried fruits. By Division of Pomology, U. S. Department of Agriculture.
7. Raisins. By Samuel N. Androus, Pomona, California.

Subsection G.

1. Pineapples, peaches, apples. By Martin Wagner & Co., Baltimore, Maryland.
2. Peaches. By E. B. Mallory & Co., Baltimore, Maryland.
3. Pineapples, peaches, pears, plums, cherries, strawberries, raspberries, blackberries. By William Numsens & Sons, Baltimore, Maryland.
4. Pineapples, crabapples, pears, barberries, huckleberries, blackberries. By F. H. Perry, Providence, Rhode Island.
5. Pineapples, peaches, crabapples, raspberries, blackberries. By J. T. Myer & Co., Baltimore, Maryland.
6. Apples, pears, cherries, raspberries. By Erie Preserving Company, Buffalo, New York.
7. Apple butter, raspberry jam. By H. J. Heinz & Co., Pittsburg, Pennsylvania.
8. Peaches. By Sears & Nichols, Chillicothe, Ohio.
9. Pickled olives. By George F. Hooper, Sonoma, California.

Subsection H.

1. Olive oil. By George F. Hooper, Sonoma, California.
2. Olive oil. By E. E. Goodrich, Santa Clara, California.
3. Olive oil. By G. P. Rixford, San Francisco, California.
4. Jujube berries. By G. P. Rixford, San Francisco, California.
5. Olive oil. By Charles A. Wetmore, Livermore, California.
6. Olive oil, special exhibit of grades of crop of 1889. By E. E. Goodrich, Santa Clara, California.
7. Series of water-color paintings of citrus, subtropical, orchard, and small fruits. By Division of Pomology, U. S. Department of Agriculture.
8. Photographs of orchard and fruit farm scenes. By Division of Pomology, U. S. Department of Agriculture.

SECTION VI.—VITICULTURE. (DIVISION NO. 1, EXCLUSIVE OF CALIFORNIA.)

Illustrations.—Part 1.—Grapes.

1. Catawba grape, natural size.
2. Two clusters Delaware grape, natural size.
3. Cluster of Diana, natural size.
4. Two clusters Clinton, natural size.
5. One cluster Creveling, natural size.
6. One cluster Salem, natural size.
7. One cluster Concord, natural size.
8. One cluster Rogers No. 4, natural size.
9. Two clusters Elvira, natural size.
10. Branch of Prentiss, from photograph.
11. Cynthiana-Norton, reduced one-half.
12. Herbemont, reduced one-half.
13. Goethe (Rogers Hybrid No. 1).
14. Amber, reduced one-half.
15. Martha, reduced one-half.
16. Delaware in fruit, from photograph.
17. Worden in fruit, from photograph.
18. La Folle Noire, long pruning from To-Kalon vineyards, Napa County, California.
19. Zinfandel, short pruning from same vineyards.
20. Mataro, short pruning from same vineyards.
21. Carignan, long pruning from same vineyards.
22. Burger, short pruning from same vineyards.
23. Black Burgundy, long pruning from same vineyards.
24. Chasselas Noir, long pruning from same vineyards.
25. Catawba, native.
26. Clairette Blanche.
27. Black Hamburg.
28. Flaming Tokay.
29. Mission.
30. Muscat Gordo Blanco.
31. Zinfandel.
32. Burger.

Illustrations.—Part 2.—Cultivation.

1. Grape cuttings.
2. Grape cuttings rooted, one year.
3. Grafted cuttings.
4. Grape grafting by inarching.
5. Cleft grafting by one and two scions.
6. Cleft grafting plants and cuttings.
7. Whip-graft or Champin graft for small stock or cuttings.
8. Grafting knife.
9. Improved whip graft (La greffe Champin).
10. Improved whip graft completed.
11. Improved whip or Champin graft ready for the clay covering.

12. Cutting grafted (*à la* Champin).
13. Grafting on layered cane.
14. Layering from cane on trellis.
15. Method of training on three or four wire trellis.
16. Cutting bud and preparation of stock for inserting.
17. Pruning knives and budding knives.
18. Pruning shears and saws, gathering scissors, and spraying pumps.
19. Apparatus for spraying vi eyards and orchards.
20. Apparatus for the application of insecticides.
21. Winter protection, covering the vine.
22. Munson's method of training native species of grapevines.

Illustrations.—Part 3.—Manufacture.

1. Power press with double platform. (Boomer and Boschert).
2. Heald's hydraulic wine press, patented, operated by steam.
3. Heald's patent elevator for carrying grapes to the crusher.
4. The To-Kalon vineyards, winery, and wine vaults, Oakville, Napa County, California.
4*a*. Different view of same.
5. Residence and vineyards of proprietor To-Kalon vineyards, Napa County, California.
5*a*. Different view of same.
6. Englenook wine cellar, Rutherford, California.
7. Cellars of the Hammondsport Wine Company, Hammondsport, New York.
8. Germania wine cellars, Hammondsport, New York.
9. Cellars of the Lake Keuka Wine Company, near Hammondsport, New York.
10. Vineyard scene near Lake Keuka, New York, picking grapes for wine.
11. Vineyard scene on Lake Keuka, New York, planting terrace on hillsides.
12. ——.
13. The Gast Wine Company, vineyard and cellar, near St. Louis, Missouri.
14. Cellars of G. Groezinger, Yountville, California.
15. Storage cellars of Kohler & Frohling, capacity 300,000.
16. Cellars and buildings of the Pleasant Valley Wine Company.
16*a*. Storage cellars for still wines, Pleasant Valley Wine Company.
16*b*. Finishing champagne, Pleasant Valley Wine Company.
16*c*. Champagne wine vaults, Pleasant Valley Wine Company.
16*d*. Champagne bottling room, Pleasant Valley Wine Company.
16*e*. Photographic view, Pleasant Valley Wine Company; taken October, 1888.
16*f*. Double platform power press, Pleasant Valley Wine Company.
16*g*. Fermenting room, Pleasant Valley Wine Company.
16*h*. Clearing table, Pleasant Valley Wine Company.
16*i*. Champagne finishing-room, Pleasant Valley Wine Company.
17. New Urbana Wine Company, building and cellars, Hammondsport, New York.
17*a*. Still wine vaults, New Urbana Wine Company.
17*b*. Press-room, New Urbana Wine Company.
17*c*. Champagne bottling cellar, New Urbana Wine Company.
17*d*. Champagne wine vault, New Urbana Wine Company.
17*e*. Champagne finishing-room, New Urbana Wine Company.
18. Cellars and buildings of the American Wine Company, St. Louis, Missouri.
19. Cellars and vineyards of the Stone Hill Wine Company. Hermann, Missouri.
20. Plans of H. W. Crabb, wine cellar, one building, arrangement of cooperage.
21. Vineyard scene in October, canes trained on three wires.
22. Shipping grapes in October, Hammondsport, New York.

Illustrations.—Part 4.—Diseases of the vine.

1. Downy mildew (*Peronospora viticola*), showing effect upon the leaves.
2. Downy mildew on berries.
3. The black rot (*Physalospora bidwellii*), from photograph of diseased cluster.
4. Mildew and rot of the grapevine.
5. Powdery mildew (*Uncinula spiralis*), mature form.
6. Anthracnose (*Sphaceloma ampelinum*).
7. Diseases of the grape leaf.

Exhibits.—Part 1.—Collection of native vines, by T. V. Munson, Denison, Texas.

1. *Vitis rupestris*, Sheele.
2. *Vitis riparia*, Mchx.
4. *Vitis solonis*, Eng.
6. *Vitis turneri*, Munson.
7. *Vitis arizonica*, Eng.
8. *Vitis leucobrya*, Munson.
9. *Vitis cordifolia*, Mchx.
11. *Vitis rubra*, Mchx.
12. *Vitis monticola*, Buckley.
13. *Vitis labrusca*, Linn.
    Variety *romanti*, Rom.
14. *Vitis doaniana*, Munson.
15. *Vitis candicans*, Engl.
16. *Vitis coriacea*, Shutt.
16*b*. *Vitis vinifera*, Linn.
16*c*. *Vitis linsecomii*, Buckley.
21. *Vitis æstivalis*, Engl.
22. *Vitis cinerea*, Engl.
25. *Vitis berlandieri*, Planch.
26. *Vitis munsoniana*, Simpson
27. *Vitis rotundifolia*, Mchx.

Exhibits.—Part 2.—Collection of rooted plants of native vines, by T. V. Munson, Denison, Texas.

GENUS VITIS. (Species arranged by T. V. Munson.)

Section 1.—*Euvitis* (Planchon).

Series 1.

Ripariæ.

1. *V. rupestris* (Sheele), 2 plants. Southwest Texas.
2. *V. riparia* (Mx.), 1 plant. Wisconsin.
   V. riparia, 1 plant. Minnesota.
3. *V. solonis* (Engelman), 1 plant. Northwest Texas.
   V. novo mexicana (Munson).
4. *V. doaniana* (Munson), 1 plant. Northwest Texas.

Series 2. Leucobryæ.	5. *V. arizonica* (Eng.), 1 plant. Phœnix, Arizona. 6. *V. californica* (Benth.), 1 plant. Sacramento River, California.
Series 3. Cordifoliæ.	7. *V. cordifolia* (Mx.), 1 plant. North Texas. 8. *V. ruba* (Mx.), 1 plant. E. Mo., Miss. River. *V. palmata* (Eng). 9. *V. monticola* (Buckley), 1 plant. Southwest Texas. *V. texana*, Munson, *V. foereana*, Planchon.
Series 4. Labruscæ.	16. *V. labrusca* (Lin.), 1 plant. Massachusetts.
Series 5. Labruscoideæ.	17. *V. coriacea* (Shutt.), roots. Southwest Florida. 18. *V. candicans* (Engel'm), roots. North Texas.
Series 6. Viniferæ.	(A.) *V. vinifera* (L), 1 plant, Zinfandel, Var. (C.) *V. bourquinana* (Munson), 1 plant. ("Brown French.")
Series 7. Aestivales.	13. *V. æstivalis* (Michaux), roots. North Georgia. (*V. palmata*, Vahl.) 14. *V. bicolar* (Leconte), roots. Michigan. 15. *V. linsecomii* (Buckley), 1 plant. Southwest Missouri.
Series 8. Cinerascentes.	10. *V. berlandieri* (Planch.), 1 plant. Southwest Texas. (*V. monticola* (Millardet.) 11. *V. cinerea* (Eng.), 1 plant. North Texas. 12. *V. simpsonii* (Munson), roots. Southwest Florida. (C). *V. caribœa* (D. C.), no specimens. West Indies.

Section 2. *Lenticelia* (Munson).

Series 1. Tendronæ Simplesis.	19. *V. munsoniana* (Simpson), 1 plant. Southwest Florida. 20. *V.* ——, 1 plant. South Carolina. (*V. rotundifolia*, Mchx.)

VITICULTURE (DIVISION No. 2, CALIFORNIA).

[Experimental cellar, State Viticultural Commission, San Francisco, California.]

Five cases, containing as follows:

Case No. 1.—Two bottles Zinfandel, 1886; 2 bottles Zinfandel, 1887; 2 bottles Mataro, 1886; 2 bottles Mataro, 1887; 2 bottles Carignan, 1886; 2 bottles Mondeuse, 1886.

Case No. 2.—Two bottles Mondeuse, 1887; 2 bottles Petite Syrah, 1886; 2 bottles Médoc Type A, 1886; 2 bottles Médoc Type B, 1886; 2 bottles Cabernet and Tannet blend, 1886; 2 bottles Burgundy, 1884.

Case No. 3.—Two bottles Burgundy, 1886; 2 bottles Petit Periot, 1887; 2 bottles Johannisberg Riesling, 1886; 2 bottles Franken Riesling, 1886; 2 bottles Sauvignon Vert, 1886; 2 bottles Chablis, 1884.

Case No. 4.—Two bottles Chablis, 1886; 2 bottles Sauterne, 1886; 2 bottles Sauterne, 1887; 2 bottles Semillion 1886; 2 bottles Chaudre Gris, 1886; 2 bottles port, 1886.

Case No. 5.—Two bottles Frontignan, 1886; 2 bottles brandy, 1883; 2 bottles brandy, 1886; 2 bottles Folle Blanche, 1885: 2 bottles Meunier, 1886.

[Chas. A. Wetmore, Cresta Blanca Vineyard, Livermore, Alameda County, California.]

Case No. 6.—One case, containing as follows: Two bottles Medoc Souvenir A, 1886; 2 bottles Médoc Souvenir B, 1886; 2 bottles Sauterne Souvenir, 1886; 2 bottles table d'hôte, 1886.

The Cresta Blanca vineyards are on rolling land, yellow loam intermixed with gravel, and seem to produce fine quality.

[Kohler & Frohling, wine merchants, San Francisco, California.]

Eight cases, assorted as follows:

Case No. 7.—One case, containing 4 bottles brandy, Glen Ellen, Sonoma County, 1884; 4 bottles brandy, 1886; 4 bottles brandy, Glen Ellen, Sonoma County, 1887.

Case No. 8.—One case, containing 4 bottles Muscat, 1880; 4 bottles superior port; 4 bottles best port.

Case No. 9.—One case, containing 4 bottles brandy, Los Angeles, 1886; 4 bottles brandy, Los Angeles pomace, 1886; 4 bottles brandy, Los Angeles, Folle Blanche, 1886.

Case No. 10.—Four bottles brandy, Los Angeles, 1887; 4 bottles Angelica; 4 bottles Madeira.

Case No. 11.—Twelve bottles old Zinfandel.

Case No. 12.—Twelve bottles Zinfandel.

Case No. 13.—Twelve bottles Gutedel (Chasselas).

Case No. 14.—Twelve bottles Riesling.

Messrs. Kohler & Frohling represent the oldest wine firm in the State. Their Glen Ellen vineyards are in Sonoma County, on rolling hill land, mostly deep red soil containing a large percentage of iron, intermixed with gravel. Their vineyards at Los Angeles are within the city limits, on deep, rich, sandy bottom land.

[J. Gundlach & Co., San Francisco, Rhinefarm, Sonoma.]

Case No. 15.—One case, containing Cabinet Riesling, vintage 1879.

Case No. 16.—One case, containing Cabinet Riesling, vintage 1881.

Case No. 17.—One case, containing Gutedel (Chasselas), vintage 1888.

Case No. 18.—One case, containing Gutedel (Chasselas), vintage 1880.

Case No. 19.—One case, containing Burgundy, vintage 1882.

Case No. 20.—One case, containing Burgundy, vintage 1883.

Case No. 21.—One case, containing Huichica Claret, vintage 1884.

Case No. 22.—One case, containing Cabernet Sauvignon, vintage 1884.

Case No. 23.—One case, containing Zinfandel, vintage 1883.

Case No. 24.—One case, containing Zinfandel, vintage 1884.

The wines of Messrs. Gundlach & Co. are mostly from Sonoma Valley and products of their own vineyards, though some were purchased by them when young. They may be considered typical vines of that section, which is on the eastern side of Sonoma Valley, rather cold and wet lands, but inter-

mixed with lime, disintegrated from the hills. The soil is rather poor and shallow in places, being but 18 inches to 3 feet above the bed rock, which is a limestone formation. One of the oldest firms in the State, and their wines bear a good reputation.

[C. Schilling and Co., San Francisco, California.]

Five cases, containing the following:

Case No. 25.—One case, containing 12 pints Cabernet Sauvignon, vintage 1885, grown by J. H. Drummond, Dunfillan Vineyards, Glen Ellen, Sonoma County, California; 12 pints Burgundy and Pinot, upper Sonoma Valley.

Case No. 26.—One case, containing 12 bottles, pints, Gros Manien, 1886, grown by J. H. Drummond, Dunfillan Vineyards, Glen Ellen, Sonoma County, California; 12 bottles, pints, Zinfandel, 1886, grown at St. Helena, Napa County, California.

Case No. 27.—One case, containing 6 bottles, quarts, of Semillion, vintage 1885, grown at Glen Ellen, Sonoma County, California; 6 bottles, quarts, of Riesling, vintage 1879, grown by H. Winkle, Sonoma, Sonoma County, California.

Case No. 28.—One case, containing 6 bottles, quarts, of Gutedel (Chasselas Fontainbleau) vintage 1883, grown by T. S. Glaister. Sonoma, California; 6 bottles, quarts, of hock, vintage 1884, a blend of Riesling and Chasselas, grown in Napa and Sonoma counties.

Case No. 29.—One case, containing 6 bottles port, of vintage 1886, from San Bernardino County, California; 6 bottles Angelica, vintage 1886, San Bernardino County, California; 6 bottles Muscat, vintage 1886, foothills of Yolo County, California; 6 bottles sherry, vintage 1883, from Sacramento, California.

Messrs. C. Schilling & Co. are prominent dealers in wines in San Francisco, and obtain most of their dry wines from Napa and Sonoma counties.

[Napa Valley Wine Company, cellars at Napa; commercial business at San Francisco.]

Five cases, containing as follows:

Case No. 30.—One case, twelve bottles, Carignan, vintage 1886.

Case No. 31.—One case, twelve bottles, Burgundy, 1886.

Case No. 32.—One case, twelve bottles, Cabernet Sauvignon, 1885.

Case No. 33.—One case, twelve bottles, Gutedel (Chasselas), 1883.

Case No. 34.—One case, six bottles, Tokay, 1883; six bottles brandy, 1881.

These wines are all from Napa County, mostly from deep, rich, loamy valley lands, intermixed with gravel. The company have their vineyards and wine cellars in Napa Valley; their offices in San Francisco. Mr. E. C. Priber is business manager; Mr. Lochman, at Napa, foreman of winery.

[Jacob Schram, St. Helena, California.

Case No 35.—One case, containing 4 bottles hock, vintage 1885; 4 bottles Riesling, vintage 1885; 4 bottles Burgundy, vintage 1885.

Mr. Schram's wines are from mountain vineyards above St. Helena; mostly reddish, gravelly soil; steep hillsides, containing a good deal of iron.

[Beringer Bros., St. Helena, Napa County, California.]

Case No. 36.—One case, containing 2 bottles brandy, 1883; 2 bottles brandy, 1886; 2 bottles brandy, 1888; 2 bottles Riesling, vintage 1885; 2 bottles Burger, vintage 1885; 2 bottles Gutedel (Chasselas), 1885.

The wines are from hillside grapes mostly, which has soil of a reddish, gravelly loam.

[Henry Hagen, Cedar Knoll Vineyards, Napa County.]

Case No. 37. One case, containing as follows: Two bottles Riesling; 2 bottles Zinfandel; 2 bottles port; 2 bottles Angelica; 2 bottles Malaga; 2 bottles brandy.

No age given. The vineyard is on the eastern side of Napa Valley, rising to the foothills, soil grayish, gravelly, rather shallow, but has always made wine of good quality.

[C. P. Adamson, Rutherford, Napa County, California.]

Case No. 38.—One case assorted as follows: 2 bottles Zinfandel, vintage 1884; 2 bottles Zinfandel, vintage 1885; 2 bottles Carignan, vintage 1886; 2 bottles Riesling, vintage 1885; 2 bottles Sauvignon best, vintage 1886; 2 bottles Palomino, vintage 1886.

The vineyard of Mr. Adamson is a deep rich loam, intermixed with gravel, on the eastern side of the valley (Napa), made up mostly by wash from the hills, carried down and deposited by Chilis Creek.

[J. Matthews, Lisbon Winery, Napa, California.]

Case No. 39.—One case, containing 3 bottles Riesling, vintage 1887; 3 bottles sherry, vintage 1887; 3 bottles Zinfandel, vintage 1887; 3 bottles dry sherry made from claret grapes, 1887.

Mr. Matthews buys his grapes from the vicinity of Napa, and manufactures mostly sherry and claret.

[A. G. Chauche, Mont Rouge Vineyards, Livermore, Alameda County, California.]

Case No. 40.—One case Sauterne, vintage 1886.

Case No. 41.—One case Haut Sauterne, vintage 1886.

Made from a blend of Sauvignon Blanc, Semillion, and Muscatel de Bordelais; soil, yellow, gravelly loam; Livermore Valley.

[A. Brun & Co., Nouveau Medoc, Oakville, Napa County, California.]

Case No. 42.—One case, containing as follows: 3 bottles Riesling, vintage 1884; 3 bottles Catawba, vintage 1884; 3 bottles Carignan, vintage 1884; 3 bottles Zinfandel, vintage 1884.

Made mostly from valley grapes, grown on deep rich soil, loam mixed with gravel.

[Ewer & Atkinson, Rutherford, Napa County, California.]

Case No. 43.—One case, containing as follows: 2 Sauvignon Vert, vintage 1886; 2 Riesling, vintage 1886; 2 Riesling, vintage 1885; 2 Zinfandel, vintage 1885; 2 Burgundy, vintage 1886; 2 Lenoir.

These wines were all produced on very rich bottom soil, some of the grapes bearing 12 tons to the acre.

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[Arpad Haraszthy & Co., San Francisco, California.]

Case No. 44.—One case Eclipse, extra dry, vintage 1884.
Case No. 45.—One case Eclipse Bruit, vintage 1884.
Case No. 46.—One case Orleans Riesling, vintage 1884.
Case No. 47.—One case Gutedel (Chasselas), vintage 1883.
Case No. 48.—One case Gerke blend of wines, from Orleans Vineyard, vintage 1885.
Case No. 49.—One case Zinfandel, vintage 1886.
The above wines are mostly from Orleans Vineyard, Yolo County, California, except the sparkling wines, which are a blend of 9 varieties of grapes from Sonoma, Napa, Alameda, Santa Cruz, Santa Clara, and Yolo counties. The soil of the Orleans Vineyard contains a great deal of iron and lime, and the vineyards are all on the hillsides, where grapes ripen very early.

[Adolph Beck, San Francisco, California.]

Case No. 50.—One case, assorted as follows: Three bottles Riesling, vintage 1885; 3 bottles Cabernet, vintage 1885; 3 bottles port, vintage 1881; 3 bottles Burgundy, vintage 1883.
Mr. Beck is a wine merchant and can only say that the Sauvignon Vert and Cabernet were purchased in Napa, and the Burgundy was made from grapes grown in Sonoma Valley.

[Charles Krug, St. Helena, Napa County, California.]

Case No. 51.—One case, assorted as follows: Two bottles Gutedel (Chasselas Fontainebleau), 1886; 2 bottles Riesling, 1886; 2 bottles Zinfandel, 1886; 2 bottles Mondeuse, 1886; 2 bottles sweet Muscatel, 1886; 2 bottles brandy, 1888.
Mr. Krug's vineyard is mostly rich valley land, a deep loam mixed with gravel.

[A. Grossman, Napa, California.]

Case No. 52.—Six bottles Mountain Zinfandel.
Grown on hillside, east of Napa, on red soil, containing a good deal of iron.

[H. W. Crabb, To-Kalon Vineyard, Oakville, Napa County, California.]

Case No. 53.—Three cases, assorted as follows: One case, 2 bottles Sauterne; 2 bottles Tokay; 2 bottles Gutedel (Chasselas Fontainebleau); 2 bottles Muscatel; 2 bottles sherry; 2 bottles Riesling; 2 bottles brandy, 1884; 2 bottles brandy, 1886; 2 bottles brandy, 1888; 2 bottles Beclan; 2 bottles Chambertin; 2 bottles Madeira; 2 bottles Malaga; 2 bottles claret; 2 bottles Burgundy; 2 bottles(port, 1880; 2 bottles port, 1884; 2 bottles Zinfandel.
Mr. Crabb's vineyard is in the middle of Napa Valley, all rich valley land, gravelly loam.

[Purity Wine Company.]

Case No. 56.—The wines in this case are all of the vintage of 1887, containing claret and white wine made from Folle Blancne, the claret from Zinfandel, both grown at Natoma, Sacramento County. They were treated by the electric process described in the circular inclosed in the case, showing a marked degree of development. They are accompanied by samples of the same wine, as it appeared before treatment.

[Alfred Greenbaum & Co., San Francisco, California.]

Three cases, assorted as follows:
Case No. 57.—One case, containing 3 bottles hock, Inglenook wine cellars, Rutherford; 3 bottles Gutedel, Inglenook wine cellars, Rutherford; 3 bottles Riesling, Inglenook wine cellars, Rutherford; 3 bottles Burger, Inglenook wine cellars, Rutherford.
Case No. 58.—One case, containing 3 bottles Zinfandel, Inglenook wine cellars, Rutherford; 3 bottles claret; 3 bottles Burgundy; 3 bottles Sauterne.
Case No. 59.—One case, containing 3 bottles sherry, from L. J. Rose Company, San Gabriel; 3 bottles port, from L. J. Rose Company, San Gabriel; 3 bottles brandy, from L. J. Rose Company, San Gabriel; 2 bottles Angelica, from L. J. Rose Company, San Gabriel; 1 bottle Muscat, from L. J. Rose Company, San Gabriel.

[Ben Lomond Wine Company, Mr. Wilkins, Agent, Santa Cruz County, California.]

Case No. 60.—One case, containing 12 bottles white wine, vintage 1886.
The wines above are from a mountainous region, mostly from deep red soil, rich in iron, intermixed with stone.

[W. O. Craig, Sonoma, California.]

Case No. 61.—One case, 6 bottles (blend), Riesling & Chasselas, vintage 1885.

[Nouveau Clos Vougeot, V. Courtois, manager, St. Helena, Napa County, California.]

Case No. 62.—One case containing 4 bottles Chambertin, 1883; 4 bottles Burgundy, 1884; 4 bottles Zinfandel, 1886.
Case No. 63.—One case containing 3 bottles Angelica, 1887; 3 bottles port, 1885; 3 bottles sherry, 1886; 3 bottles brandy, 1888.
Case No. 64.—One case containing 4 bottles Sauterne, 1885; 4 bottles Sauvignon, 1886; 4 bottles hock, 1886.

[Mrs. J. C. Weinberger, St. Helena, California.]

Case No. 65.—One case containing 3 bottles Riesling, vintage 1877; 3 bottles Riesling, vintage 1885; 2 bottles Zinfandel, vintage 1886; 2 bottles sherry; 2 bottles grape brandy, vintage 1881.
Mrs. Weinberger's wines are partly from the hills, with red soil, containing iron; partly from rich, gravelly bottom lands, near St. Helena, Napa County.

[J. de Turk, Santa Rosa, Sonoma County, California.]

Case No. 66.—Twelve bottles Riesling.
Case No. 67.—Twelve bottles Zinfandel.
Case No. 68.—Twelve bottles sherry.
Case No. 69.—Twelve bottles brandy.
Mr. de Turk is a very large manufacturer, and buys grapes from all parts of upper Sonoma County, mostly from hill lands, with a diversity of soils.

[Experimental cellar, State University, Berkeley, Alameda County, California.]

Case No. 70.—One case, containing as follows: (The list was mislaid in the hurry of packing, but will be furnished later. The wines are all of last season's vintage, fermented in 5-gallon kegs, therefore must be judged with due allowance for their age.)
Case No. 71.—Trunk of oldest orange tree in California, from B. F. Lelong.
Case No. 72.—One box raisins, Muscatel, Henry Orestott, Placer County, California.
Case No. 73.—One box raisins, Thompson's seedless.
This is a new grape, resembling the Sultana, but better in quality, as the originator claims, and much more productive.

[G. Megliavalla, Napa, California.]

Case No. 74.—One case of wine; 12 bottles claret.
Mr. Megliavalla confines himself almost entirely to claret, for which he buys the grapes in Napa Valley, and manufactures about 300,000 gallons per annum.
Case No. 75.—Condensed must. Samples furnished by Prof. E. W. Hilgard, State University, Berkeley, California.
Case No. 76.—Soils from experimental grounds of State University.

Exhibits, Part 3, *Manufacture.—Collection of wines and brandies, and other vineyard products of American vineyards.*

No. 1.—American Wine Company, St. Louis, Missouri: One dozen Cook's Imperial, extra dry, a sparkling wine from Catawba grapes; 1 case, 2 dozen pints, of same; 1 case, duplicate specimens red wine from Concord, Virginia, seedling (Norton), Ives seedling, Catawba, and Burgundy (Cynthiana).
The wines of this company are made from grapes grown on an island in Lake Erie.
No. 2.—N. W. Craft, Shore, North Carolina, one case of wine.
No. 3.—Edge Hill Wine Company, St. Helena, California; agency, 12 Barclay street, New York city: Two cases containing specimens cabinet Riesling, cabinet hock, Sauterne, golden Chasselas, cabinet claret, select claret, Zinfandel claret, cabinet Burgundy, sweet Muscatel, sweet Tokay, cabinet port, and brandy.
No. 4.—Gast Wine Company, St. Louis, Missouri: One case containing 6 bottles Norton, vintage 1886; 6 bottles Iona, vintage 1886; 3 bottles Taylor, vintage 1887; 3 bottles Hermann, vintage 1887; 3 bottles Elvira, vintage 1888; 3 bottles Martha, vintage 1887; 1 bottle Delaware, vintage 1880; 3 bottles Norton, vintage 1880; 1 bottle Iona, vintage 1883; 3 bottles Missouri Riesling, vintage 1887; 1 bottle Ironclad, vintage 1888.
No. 5.—George F. Hooper, Sobre Vista Vineyard, Sonoma, California: One case containing 4 bottles Riesling, vintage 1874; 4 bottles Riesling, vintage 1884; 4 bottles Riesling, vintage 1886. One case containing 6 bottles Zinfandel, vintage 1881; 6 bottles Zinfandel, vintage 1882. One case containing 6 bottles sweet Muscatel, vintage 1881; 3 bottles Mission, vintage 1873; 3 bottles brandy distillat, vintage 1885.
No. 6.—Monticello Wine Company, Ch rlottesville, Virginia. One case containing 1 bottle Cythiana, vintage 1887. One case containing 10 bottles Virginia hock, blended wine from 6 varieties; 2 bottles brandy (Piquet), distillat, 1881. One case containing 3 bottles Norton, 3 bottles Clinton, 3 bottles Ives, 3 bottles claret Virginia (Concord), 1883.
No. 7.—Pleasant Valley Wine Company, Rheims, Steuben County, New York: One case containing 1 dozen Great Western extra dry (quarts). One-half case same (pints). This wine is made by blending select samples of Delaware, Iona, Elvira, and others. One case containing 1 dozen bottles Delaware. One case containing 1 dozen sweet Catawba. One case containing 1 dozen dry Catawba.
No. 8.—Alexander W. Pearson, Vineland, New Jersey: One case containing 1 dozen Burgundy (Ironclad), vintage 1888.
No. 9.—Adolph Russow, Proffits post-office, Virginia, 1 case Norton, vintage 1887.
No. 10.—G. F. Ryckman, Brocton Wine Company, Brocton, New York: One case containing 2 bottles Imperial Champagne; 2 bottles Brocton port, vintage 1874; 2 bottles sweet Catawba, vintage 1878; 2 bottles dry Catawba, vintage 1878; 2 bottles dry Iona, vintage 1873; 2 bottles Regina, vintage 1873; 2 bottles Niagara, vintage 1885.
No. 11.—Sonoma Wine and Brandy Company, No. 1 Front street, New York city: Specimens from cellars of George West, Stockton, California. One case containing 2 bottles brandy (from Folle Blanche) distillat, 1885; 2 bottles Frontignan.
No. 12.—Stone Hill Wine Company, Hermann, Missouri. One case containing 3 bottles Catawba, 3 bottles Missouri Riesling, 3 bottles Goethe, 3 bottles Taylor's Bullitt. One case containing 3 bottles Rulander, 3 bottles Concord, 3 bottles Ives' seedling, 3 bottles Norton.
No. 13.—To Kalon vineyards, H. W. Crabb, proprietor, Oakville, California (stock by Pohndorff & Co., Washington, District of Columbia). Claret from Zinfandel, Carignan, Mataro, Petite Bouschet. special claret—Zinfandel, Burgundy, Malbec, Petite Sirrah; Chambertin—Cabernet, Sauvignon; Black Pinot, Zinfandel; Burgundy—Burgundy, Trousseau, and Zinfandel; Zinfandel—Zinfandel; Beclan—Beclan; Riesling—Sylvaner, Semillon, and Muscatel; Gutedel—Chasselas, Fontainebleau; Chablis—Pinot Chardonay and Sauvignon Verte; White Pinot—White Pinot and Sauvignon Verte; Frontignan—Muscat Frontignan; Tokay—Farmint, Muscat, and Palomino; Sherry—Palomino, Muscat, and Sauvignon Verte; Muscatelle—Muscat of Alexandria; Angelica—Rose of Peru, Mission, and Malvasia; Port—Burgundy, Trousseau, and Portugueser; Malaga—Mission and Palomino; Madeira—Mission and Palomino; brandy—Mission, Folle Blanche, Sauvignon Verte. Chasselas and Riesling.
No. 14.—New Urbana Wine Company, Hammondsport, New York. One case containing 1 dozen bottles Gold Seal extra dry; 1 case containing 1 dozen bottles special dry; 1 case containing 1 dozen bottles Brut; 1 case containing 1 dozen bottles port wine; 1 case containing 1 dozen bottles sweet Catawba; 1 case containing 1 dozen bottles (St. Ives) claret.

Miscellaneous.—Fruit brandies, and wines.

No. 1.—Florida Wine Company, Clay Springs, Florida; warehouse No. 1207 Market street, Philadelphia, Pennsylvania. One case containing 1 dozen orange wine.

No. 2.—Hume & Co., 807 Market Space, Pennsylvania avenue, Washington, District of Columbia Four bottles Old Stag whisky; 4 pints Old Stag whisky; 2 pints 10-year-old apple brandy.

No. 3.—S. R. & J. C. Mott, 118 Warren street, New York city. One case sweet carbonated cider, no alcohol; 1 case containing 1 dozen golden Roussett carbonated cider.

No. 4.—Moore & Sinnott, Philadelphia, Pennsylvania: 2 pint samples Gibson's pure rye and barley malt whisky, distillat March, 1886; 2 pint samples same, distillat October, 1880.

SECTION VII—SUGAR AND SUGAR PRODUCTS.

Maple sugar.—Department of Agriculture.

Rock candy and rock candy sirup.—Department of Agriculture.

Sorghum sirup.—S. H. Kinney, Morristown, Minnesota; sugar station of Department of Agriculture at Sterling, Kansas; Douglas Sugar Company, Douglas, Kansas.

Sorghum sugar.—Conway Springs Company, Kansas; Douglas Sugar Company; S. H. Kinney, Morristown, Minnesota.

Sorghum heads.—Sterling, Kansas.

DIVISION 3.—COMMERCIAL VEGETABLE PRODUCTS, NOT FOODS.

SECTION VIII—TEXTILE FIBERS.

Subsection A.—Collection of American wools.

Exhibit 1.—From the collection of the United States Department of Agriculture. Ninety specimens in glass jars.

1 to 8. Angora goat's wool grown in Kentucky: (1) buck 2 years old; (2) kid 6 months old; (3) ewe 1 year; (4) unknown; (5) kid 9 months old; (6) ewe 2 years old; (7) buck 1 year old; (8) buck 1 year old.
9. Wristlets made from Angora fleece. Ellen Burdick, Camden, New Jersey.
10 to 16. Cotswold wool, as follows: (10) from C. F. Kingsbury, Grafton County, New Hampshire; (11 and 12) breeding ewes, John McDonald, Washington County, Pennsylvania; (13) pure bred, W. O. Thurston, Bradford, Pennsylvania; (14 and 15) (grades), H. C. Hallowell, Sandy Springs, Maryland; (16) from L. Washington, Westmoreland County, Virginia.
17 to 23. Cotswold wools contributed by the Louisville and Nashville Railroad, Kentucky: (17) ram 1 year old; (18) ewe 4 months old; (19) ewe 6 months old; (21) premium ram lamb; (22) ram 4 months old.
24. Angora goat, Kentucky.
25. Cotswold ewe, H. H. Mattock, McMinn County, Tennessee.
26. Cotswold ewe, B. M. Hard, Nashville, Tennessee.
27. Cotswold ewe, J. R. Hill, Franklin, Tennessee.
28. Cotswold (common), J. W. Blackburn, Buchanan County, Missouri.
29. Cotswold (ram), George Grant, Ellis County, Kansas.
30. Angora fleece. Angora Robe and Glove Company, San José, California.
31. Cotswold and Albert, H. C. Hallowell, Sandy Springs, Maryland.
32. Cotswold pure bred, C. M. Lord, Winona County, Minnesota.
33. Catswold ram, 1 year, H. C. Hallowell, Sandy Springs, Maryland.
34. Cotswold and Bakewell, W. H. Broadders, Fayette County, Indiana.
35. Cotswold and Shropshire, C. F. Kingsbury, Grafton County, New Hampshire.
36 to 39. Cotswold and Leicester—(grade, common): (36) E. B. Drew, Winona County, Minnesota; (37) S. C. Polter, Webster, New Hampshire; (38) James Comtney, Westmoreland County, Virginia; (39) B. T. Perry, Olmstead, Minnesota.
40 and 41. Liecester ewe lambs, J. Winne, Albany County, New York.
42. Leicester, 1 year old, Dr. Wm. Williams, Edgefield County, Tennessee.
43. Liecester, B. T. Berry, Olmstead County, Minnesota.
44. Liecester full blood, ———.
45. Liecester and merino, C. M. Lord, Winona County, Minnesota.
46. Southdown full blood, E. Jessops, York County, Pennsylvania.
47. Southdown, T. S. Gold, West Cornwall, Connecticut.
48. Southdown (grade), York County, Pennsylvania.
49. Southdown (ewe), Campbell Brown, Spring Hill, Tennessee.
50. Southdown, George Grant, Ellis County, Kansas.
51. Southdown (grade), J. W. Blackburn, Sparta, Maryland.
52. Cotswold crossed on Southdown ewe, Erastus Corning, Albany, New York.
53. Cotswold and Merino, S. C. Pattes, Webster, New Hampshire.
54. Cotswold and Merino, Benjamin Sayre, Albany, New York.
55. Lincolnshire, 1 year old, M. M. Kay, Rockport, Indiana.
56. Oxford Down from Kan as.
57. American Merino, C. F. Kingsbury, Grafton County, New Hampshire.
58 to 76. American Merino, as follows: (58) From C. F. Kingsbury, Grafton County, New Hampshire; (59) H. C. Runnell, Addison County, Vermont; (60) Wm. H. Delong, Addison County, Vermont; (61) Brandon, Vermont; (62) ewe, R. Van Voorhis, Monongahela City, Pennsylvania; (63) ram, John McDowell, Washington County, Pennsylvania; (64) ı year old; (65) ewe from the above; (66) 10 months ewe, W. L. Archer, Pennsylvania; (7 to 70) John McDowell, Washington County, Pennsylvania; (71) W. L. Archer, Burgettstown, Pennsylvania; (72) ewe, 4 years old, W. G. Markham, Aven, New York; (73) samples from Nashville, Tennessee; (74) ewe, 15 months old, L. Archer, Kansas City, Missouri; (75) pure bred, John Halter, Crowley County, Kansas; (76) buck, R. Van Voorhis, Monongahela City, Pennsylvania.
77 to 80. Saxon Merino, John McDowell, Washington County, Pennsylvania; (77) ewe; (78) buck lamb; (79) buck lamb; (80) ram.
81 and 82. Silesian Merino, John McDowell, Washington County, Pennsylvania; ewe and ewe lamb.
83. Leicester, 2 years old, Dr. Wm. Williams, Edgeville, Tennessee.
84. American Merino, V. Rich, Addison County, Vermont.
85. Leicester ram, 13 months old, J. Winne, Albany, New York.
86. Saxony Merino ewe, J. McDowell, Washington County, Pennsylvania.
87. Grade Cotswold, H. C Hallowell, Sandy Springs, Maryland.
88. Cotswold ram, W. P. Turner & Sons, Tennessee.
89. American Merino, J. McDowell, Washington County, Pennsylvania.
90. Cotswold, Louisville and Nashville Railroad.

Exhibit 2.—Series of commercially-graded wools from Justice, Bateman & Co., No. 122 South Front street, Philadelphia, Pennsylvania.

91. Ohio XX fine combing, fleece washed; shrinkage, 50 per cent; clipped from improved American Merino Delaine sheep.
92. Ohio XX fine clothing, fleece washed; shrinkage, 52 per cent; clipped from American improved Merino sheep.
93. Ohio fine medium one-half blood combing, fleece washed; shrinkage, 38 per cent; clipped from cross-bred Merino sheep.
94. Ohio fine medium one half blood clothing, fleece washed; shrinkage, 40 per cent; clipped from cross-bred Merino sheep.
95. Ohio medium three-eighths blood combing, fleece washed; shrinkage, 30 per cent; clipped from cross-bred Merino sheep.
96. Ohio medium three-eighths blood clothing, fleece washed; shrinkage, 32 per cent; clipped from cross bred Merino sheep.
97. Ohio one-quarter blood combing, low medium, fleece washed; shrinkage, 23 per cent; clipped from cross-bred native or English sheep with a remote Merino cross.
98. Ohio one-quarter blood clothing, low medium, fleece washed; shrinkage, 23 per cent; clipped from cross-bred native or English sheep with a remote Merino cross.
99. Ohio coarse combing, fleece washed; shrinkage, 20 per cent; clipped from sheep of English blood.
100. Montana Territory fine unwashed delaine; shrinkage, 60 per cent; clipped from Merino sheep.
101. Montana Territory medium unwashed delaine; shrinkage, 53 per cent; clipped from cross-bred Merino sheep.
102. Kentucky medium unwashed combing; shrinkage, 40 per cent; clipped from cross-bred Merino sheep.
103. Kentucky low medium or coarse combing; shrinkage, 37 per cent; clipped from cross-bred with a remote Merino cross.
104. Rocky Mountain region X or fine unwashed; shrinkage, 70 per cent; clipped from Merino sheep.
105. Rocky Mountain region three-eighths and one-half blood medium unwashed; shrinkage, 62 per cent; clipped from cross-bred Merino sheep.
106. Rocky Mountain region one-quarter blood or low medium and coarse unwashed; shrinkage, 55 per cent; clipped from cross-bred sheep with a remote Merino cross.
107. New Mexican coarse carpet wool; shrinkage, 50 per cent; clipped from Mexican sheep originally of Spanish origin.

Exhibit 3.—Series of commercially-graded wools from Walter Brown's Son & Co., No. 29 High street, Boston, Massachusetts.

108. Ohio XXX and pick-lock, fleece washed; Merino and Saxony; wools grown principally in Ohio, Pennsylvania, and West Virginia.
109. Ohio XX and above, fleece washed; Merino; wools grown in Northern States east of Mississippi River.
110. Ohio (extra), fleece washed; principally Merino strain of Southdown; wools grown in Northern States east of Mississippi River.
111. Ohio fine delaine, fleece washed; American Merino; wools grown in Northern States east of Mississippi River, principally Ohio, Pennsylvania, Michigan, New York, West Virginia, etc.
112. Ohio No. 1 clothing, fleece washed; English Downs crossed with Merino; wools grown in Northern States east of Mississippi River, chiefly Ohio, Pennsylvania, Michigan, New York, Wisconsin, etc.
113. Ohio No. 1 combing, fleece washed; English Down, Cotswold, and Merino; wools grown in Northern States east of Mississippi River, chiefly Ohio, Pennsylvania, Michigan, New York, Wisconsin, etc.
114. Ohio No. 2 combing, fleece washed; chiefly Cotswold strain of English Downs; wools grown in Northern States east of Mississippi River, chiefly Ohio, Pennsylvania, New York, etc.
115. Indiana fine (X and above), fleece washed; American Merino; wools grown in Northern States east of Mississippi River.
116. Indiana No. 1 (one-half blood) clothing, fleece unwashed; Merino crossed on English Downs; wools grown in Northern States east of Mississippi River, chiefly New England, Virginia, Kentucky, Indiana, Illinois, Missouri, Iowa, and Wisconsin.
117. Indiana three-eighths blood, clothing, fleece unwashed; English Downs, strain American Merino; wools grown in States east of Mississippi River, chiefly New England, Virginia, Kentucky, Indiana, Illinois, Missouri, Iowa, and Wisconsin.
118. Kentucky three-eighths blood, clothing, fleece unwashed; Cotswold or Leicester crossed with strain Merino or Southdown; wools grown same as No. 117.
119. Kentucky one-quarter blood, combing, fleece unwashed; chiefly Cotswold or Leicester; wools grown same as No. 117.
120. Montana fine X and above, fleece unwashed; American Merino; wools grown in Montana, Dakota, and extreme northern Wyoming.
121. Montana fine medium and medium, fleece unwashed: American Merino; cross English Downs; wools grown same as No. 120.
122. Utah fine X and above, fleece unwashed; American Merino; wools grown in Utah, western Wyoming, Nevada, etc.
123. Utah fine medium, fleece unwashed; American Merino retaining trace of original Mexican or crossed with English Downs; wools grown in Utah, Western Wyoming, Nevada, etc.
124. Colorado fine X and above, fleece unwashed; American Merino, bred from Mexican; wools grown in Colorado, eastern Wyoming, Nebraska, Kansas, and New Mexico.
125. Colorado fine medium, fleece unwashed; American Merino, bred from the original Mexican; wools grown same No. 124.
126. Oregon, One Valley, Oregon, fleece unwashed; American Merino crossed on English Downs; wools grown in Oregon, on Pacific Slope.
127. Oregon, Two Valley, Oregon, fleece washed; American Merino crossed on Cotswold, etc; wools grown in Oregon, on Pacific Slope.
128. California, Humboldt County; a 1-spring, 8-months' growth, fleece unwashed; American Merino crossed on English Downs; wools grown in North California.
129. Texas fine, 12-months' growth, fleece unwashed; American Merino bred up from original Mexican-Texas wools of a year's growth.

Exhibit 4.—Series of commercially graded wools from James Lynch, wool broker, 194 Church street, New York City.

130. Ohio XXX, fleece washed; full-blood Merino.
131. Ohio XX, fleece washed; Merino.
132. Ohio X, fleece washed; fifty-sixth blood Merino cross.
133. Oregon (Eastern) fine, unwashed.
134. Ohio fine, unwashed; Merino.

135. Texas fine, unwashed; Merino.
136. Montana fine medium (one-half blood Merino), unwashed; one-half blood Merino.
137. California fine, unwashed; Merino.
138. Montana fine, unwashed; Merino.
139. Ohio picklock, washed; full-blood Merino.
140. New Mexican improved or medium, unwashed; three-eighths to one-half blood Merino cross.
141. Ohio medium (three-eighths to one-half blood) clothing, washed; three-eighths to one-half blood Merino cross.
142. Ohio coarse (clothing), washed.
143. Ohio one-quarter blood (clothing), washed.
144. Ohio one-half clothing, washed; one-half blood Merino cross.
145. Ohio one-quarter blood combing, washed; one-quarter blood Merino cross.
146. Ohio fine delaine (combing), washed.
147. Ohio medium (three-eighths to one-half blood) combing, washed; three-eighths to one-half blood Merino cross.
148. Ohio coarse combing, washed.
149. New Mexican carpet, unwashed; native Mexican.

Exhibit 5.—Series of commercially graded wools from Wm. Macnaughton's Sons, commission merchants, 170 South Fifth Avenue, New York.

150. Fine Montana.
151. Montana medium.
152. Texas.
153. Wyoming.
154. Georgia.
155. Kentucky combing.
156. Utah.
157. Fine combing domestic mohair.
158. Medium combing.
159. Coarse combing.
160 and 161 withdrawn.

Exhibit 6.—Series illustrating the various processes in the manufacture of ladies' dress goods. Contributed by the Arlington Mills, Lawrence, Massachusetts.

162. Manufacture; wool in the grease.
163. Manufacture; wool scoured.
164. Manufacture; noil.
165. Manufacture; "sliver" and "top."
166. Manufacture; drawing, finishing, and roving.
167. Manufacture; one-sixtieth yarn.
168. Manufacture; cloth made from the two-sixtieths and one-sixtieth worsted yarn.

Exhibit 7.—Series illustrating partial processes in the manufacture of yacht cloth. Contributed by the Middlesex Mills, Lowell, Massachusetts.

169. Manufacture; wool in natural condition.
170. Wool after being scoured.
171. Wool after being colored.
172. Roving and yarn.
173. Cloth off loom.
174. After gigging and before shearing.
175. Finished cloth.

Exhibit 8.—Series illustrating partial processes in the manufacture of bunting for flags. Contributed by the United States Bunting Company, Lowell, Massachusetts.

176. Wool in grease; quarter-blood combing wool from Missouri.
177. Scoured.
178. Tops.
179. Slubbing.
180. Roving and yarn.
181. Samples of bunting for flags, from one-quarter blood Missouri combing wool.

Subsection B.—Collection of American cotton.

Exhibit 1.—Series of cotton in seed contributed by correspondents of the Statistical Division, Department of Agriculture, showing principal varieties grown in the South. Sent by the growers.

1. Allen Silk, L. H. Middlebrooks, Sparta, Georgia.
2. Common Cluster, James C. Brown, Martin, South Carolina.
3. Jones's Prolific. W. J. Routti, Peoria, Texas.
4. Clark's Prolific, John L. Ingals, Madison, Florida.
5. Hickory Nut, Jerry Burnett, Drop, Texas.
6. Collier, J. T. Knight, Commerce, Texas.
7. Ozier, A. T. Withers, Red Banks, Mississippi.
8. Tyronza, S. A. Martin, Poindexter, Arkansas.
9. Hybrid Prolific, R. W. Jones, M. D., Bryan, Texas.
10. Myers, J. R. Ray, Austin, Texas.
11. Odom Prolific, S. B. Odom, Drayton, Georgia.
13. Java, H. H. Walker, Ripley, Tennessee.
14. Improved Lamar, J. M. McDaniel, Peoria, Texas.
15. Moonshine, James W. Bennett, Clarksburg, Tennessee.
16. Ounce Boll, Benjamin Bernett.
17. Big Boll Prolific, H. H. Walker, Ripley, Tennessee.
18. Improved Dickson, J. E. Gray, Brenham, Texas.
19. Dewalt, W. B. Dewalt, Reagan, Texas.
20. Dewalt, W. B. Dewalt, Reagan, Texas.
21. Hybrid Prolific, R. W. Jones, M. D., Bryan, Texas.
22. Thompson Big Boll, A. C. Rhodes, Barkada, Arkansas.
23. Beat All, Charles C. Sheppard, Americus. Georgia.
24. Hickory Nut, John L. Inglis, Madison, Florida.
25. Simpson's Early, S. A. Martin, Poindexter. Arkansas.
26. Farris, Master Charles Jackson, Palestine, Texas.
27. Black Seed, Alex R. Hazard, Hazen, Arkansas.
28. Storm Proof, Owen Matthews, Allen, Texas.

29. Green Seed and Ounce Boll mixed, D. F. Kerby, Adamsville, Tennessee.
30. Matagorda Silk, W. P. Thomas, Point Pleasant, Missouri.
31. Maynard's Improved Peerless, William T. Maynard, Forsyth, Georgia.
32. ———, W. S. Matthews, Allen, Texas.
33. World's Wonder, Samuel Park, Wascahachie, Texas.
34. Peterkin, James M. Mobley & Sons, Hamilton, Georgia.
35. Sugar Loaf, I. Ables, Sherman, Texas.
36. Hord's Hybrid, Sidney Shannow, Florence Station, Tennessee.
37. Yeawood's Texas, Thomas Miller, Florence Station, Tennessee.
38. Rouse Improved, W. P. Rouse, Greenville, Alabama.
39. Tomlin Storm Proof, W. R. Tomlin, Rutledge, Alabama.
40. Ozier Silk, A. H. Carrigan, Washington, Arkansas.
41. Big Boll, George F. Woeff, Goodion's Factory, South Carolina.
42. Angola cotton, James B. Dent, Arkansas.
43. Sellers's Silk, Dr. J. R. Sellers, Moslon, Tennessee.
44. Truitt's Improved Premium Prolific, Geo. W. Truitt, Lagrange, Georgia.
45. Truitt's Improved Premium Prolific, Geo. W. Truitt, Lagrange, Georgia
46. Duncan, W. E. Becker, Becker, Texas.
47. Guy's Improved, W. O. Guy, Lowrysville, South Carolina.
48. Silk, A. C. Tucker, Clarksburg, Tennessee.
49. Little Deveraux Bays, R. S. Barham, North Carolina.
50. Allen's Long Staple, Ed. B. Smith, Marion, South Carolina.

Exhibit 2.—Series of lint cottons from collection of the Department of Agriculture.

51. Premium, Pickens, Indian Territory.
52. Second Premium, Pickens, Indian Territory.
53. Third Premium, Indian Territory.
54. Egyptian, Mellborn County, Florida.
55. Short Staple Upland, New Mexico.
56. Hunt Seed, Barnwell, South Carolina.
57. Goosey, Mississippi.
58. Texas, St. Louis, Missouri.
59. Tennessee, St. Louis, Missouri.
60. Johnson, Concordia County, Louisana.
61. Tumel Maki, Bastrop, Louisiana.
62. Tahiti Seed, Arkansas River.
63. Dickson Cluster, Floyd County, Georgia.
64. Prolific, Stoddard County, Missouri.
65. Ordinary Green Seed, Desoto County, Mississippi.
66. Rio Grande Seed, Barnwell, South Carolina.
67. China, Concordia County, Louisiana.
68. Arkansas, St. Louis, Missouri.
69. Texas Prolific, Lamar County, Texas.
70. (1) Goosey, from Mississippi; (2) Zippora, from South Carolina.
71. Moina Extra Staple Upland.
72. Peeler, Desoto, Mississippi.
73. Herlong, Concordia County, Louisiana.

Exhibit 3.—Series of fine samples of lint or ginned cotton, from collection of the Department of Agriculture.

74. Constellation Superfine, Washington A. Clark, Columbia, South Carolina.
75. Improved Sea Island, Wm. G. Hinson, James Island, South Carolina.
76. Peterkin Improved, Alexander Drug and Seed Company, Augusta, Georgia.
77. Upland Cotton, John C. Calhoun & Son, from Louisville and Nashville Railroad in Alabama.
78. S. B. Maxey, cotton, Texas.

Exhibit 4.—Series of small samples of cotton in seed, from Prof. W. C. Stubbs, State experiment station, Baton Rouge, Louisiana.

79, 80, and 81. (Three cases, 42 samples, with sub-numbers as follows:) Samples marked "D" grown on experiment farm. (0) Brannon Selected; (1) Southern Hope; (2) Bancroft's Herlong; (3) Peeler; (4) Petit Gulf; (5) Allen's Long Staple; (6) Tennessee Silk; (7) Boyd's Prolific; ( ) Peterkin; (9) Crawford; (10) Hawkins; (11) Peerless; (12) Zelnero; (13) Dickson; (14) Welborn's Pet; (15) Cherry's Cluster; (16) King's Improved; (17) Hawkins (D); (18) Peterkin Home; (19) Oats Cotton; (20) Sea Island (D); (21) Sea Island; (22) Little Brannon; (23) Allen's Long Staple; (24) Boyd's Prolific; (25) Peterkin; (26) Tennessee Silk; (27) Martin's Prolific; (28) Herlong; (29) Jones's Improved; (30) Jowers; (31) S. B. Maxey; (32) Cherry's Long Staple; (33) Shimer's Early (34) Jowers's Improved; (35) Cherry's Long Staple; (36) S. B. Maxey; (37) Shimer's Early Prolific; (38) Griffin's Improved; (39) Taylor Improved; (40) Bancroft's Extra Herlong; (X) Pure Brannon.

Exhibit 5.—Small upright glass case showing cotton plants as ready for pickers in the field. Contributed by J. T. Jones, Hogansville, Troup County, Georgia.

82. Cotton plant, grown at "Farm Independence."
83. Jones's Improved cotton, one plant, grown at "Farm Independence."

Exhibit 6.—Manufacture of "Odenheimer cotton bagging," Lane mills, New Orleans, Louisiana.

84. Raw cotton and "picker" process.
85. Finished bagging and twine.

Exhibit 7.—Series illustrating the processes required to convert raw cotton into a finished spool of sewing thread. Presented by the Willimantic Linen Company, E. S. Boss, agent, Willimantic, Connecticut.

86. One case 14 feet long with examples of twenty-five processes as above. Descriptive matter in long oak frame accompanies the exhibit.

Exhibit 8.—Series illustrating partial processes in the manufacture of spun cotton and yarn used by plush manufacturers, for electrical wire-wrapping, etc. Presented by the Arlington Mills, Robert Redford, agent, Lawrence, Massachusetts.

87. Raw Florida Sea Island cotton.
88. Picker process.
89. Drawing, carding, and roving—complete series.
90. Spun cotton and yarn.

Exhibit 9.—Series illustrating partial processes in the manufacture of cotton white goods and sheeting. From the Atlantic Cotton Mills, W. F. Sherman, agent, Lawrence, Massachusetts.

91. Glass case of raw cotton and picker process.
92. Glass case with specimens illustrating roving, ring spinning, "spooler," "warper," mule spinning and No. 36 yarn.
93. Samples of seamless sheeting 2¼ yards wide.

Exhibit 10.—Series of 44 varieties of cotton, showing seed and length of staple, grown on the experiment farm of the South Carolina University. Prepared by Prof. R. H. Loughridge of the university.

94. Samples as follows: Crossland, Jeff. Welborn's Pet, Herlong, Sea Island from Upland, Dickson's Cluster, Griffin's Improved, Jones's Improved, Taylor, Peterkin, Richardson, Thomas, Cherry's Long Staple, Cobweb, Dickson's Improved, Ozier Silk, Williamson, Jones's Long Staple, Eureka, Truitt, Texas Storm Proof, Texas (Miles) Wood, Crawford's Peerless, Southern Hope, Drought Proof, Allen's Silk, Maxey's Texas, Dearning, Bahama, Duncan's Mammoth Sea Island from coast, Hawkin's, New Texas, Mammoth Cluster, Six Oaks, Peerless, Mexican Burr, Jowers's Improved, Simpson, McCall Improved, Shine's Early Prolific, Hay's China, Excelsior, Meyer's Texas, Minter's.

Exhibit 11.—Samples of cotton seed from the Alexander Drug and Seed Company, Augusta, Georgia.

95. Ozier Silk.
96. Herlong.
97. Peterkin Improved.
98. Improved Cluster.
99. Improved Sea Island.
100. Allen's Long Staple.
101. Hawkins's Improved.

Exhibit 12.—Samples of cotton seed from James R. Binford, Duck Hill, Mississippi.

102. Boyd's Prolific.
103. Peeler Long Staple.
104. Dickson Short Staple.
105. Austin's Prolific Short Staple.
106. Peerless Short Staple.

Exhibit 13.—Miscellaneous cotton-seed samples, contributed from the collection of the United States Department of Agriculture.

107. Big Boll Prolific, T. S. Edwards, Gum Log, Arkansas.
108. Finch's Selection, J. L. Finch, Stanhope, North Carolina.
109. Huebner's Improved, L. C. Lehman, Brenham, Texas.
110. S. B. Maxey cotton from Texas.
111. Mikado, T. N. White, Houston County, Georgia.
112. Abbot cotton seed, G. B. Sanders, Marion, Alabama.
113. Cluster, John Whelan, Canton, Mississippi.
114. Pelican Short Staple, J. M. Cox, Woodville, Georgia.

Exhibit 14.—Samples of cotton seed, crude cotton oil meal and oil cake, received through J. R. Binford, Duck Hill, Mississippi.

115. Seed, improved Sea Island.
116. Seed, Allen's Long Staple.
117. Seed, small black.
118. Cotton-seed hulls.
119. Raw cotton-seed meal before pressing.
120. Cooked cotton-seed meal after pressing.
121. Cotton-seed oil cake.
122. Whole cotton-seed cake.
123. Crude cotton-seed oil,

Exhibit 15.—Samples of refined cotton-seed oil from the Southern Cotton Oil Company, 80 Broad street, New York City.

124. Prime Summer Yellow.
125. Prime Summer White.
126. Prime Winter Yellow.
127. Prime Winter White.

Exhibit 16.—Official trade grades of American cotton from the New Orleans Cotton Exchange, New Orleans, Louisiana.

128. Low Ordinary.
129. Ordinary.
130. Good Ordinary.
131. Low Middling.
132. Middling.
133. Good Middling.
134. Middling Fair.
135. Fair.

Exhibit 17.—Miscellaneous.

136. Bale of Sea Island cotton, Constellation Superfine, Washington A. Clark, Columbia, South Carolina.
137. Bale of Improved Sea Island, Wm. G. Hinson, James Island, South Carolina.

Exhibit 18.—Cotton-seed oil products, from the Cotton Oil Product Company, 80 Beaver street, New York, New York.

138. Cotton oil lard (2 glass jars).
139. Cotton oil lard (10-pound pail).
140. Cotton oil lard (3 small pails).
141. Goldene for laundry use (glass jar).
142. Goldene for laundry use (packages).
143. Copco hotel toilet soap (glass jar).
144. Copco toilet, in glass-covered cases.
145. Copco laundry, in glass-covered cases.
146. Copco bath, in glass-covered cases.

Subsection C.—Flax and hemp.

Exhibit 1.—Hemp from the farm. Sent by W. B. Hawkins, Lexington, Kentucky.

1. Hemp seed.
2. Hemp stalks unrotted.

3. Hemp broken and cleaned.
4. "Shive" or waste from breaking hemp.
5. Bundle of hemp stalks from the field.

Exhibit 2.—Series illustrating the manufacture of hemp binder twine. From the Kentucky River Mills, Frankfort, Kentucky.

6. Undressed Kentucky hemp.
7. Kentucky hemp sliver.
8. Kentucky hemp tow.
9. Superior dressed Kentucky hemp.
10. Kentucky hemp binder twine.

Exhibit 3.—Series illustrating the manipulation of hemp for manufacturers' use, known as dressing. From the E. R. Sparks Hemp Company, Lexington, Kentucky.

11. Rough hemp from the farm.
12. Double dressed hemp.
13. Tow from the same.
14. Hemp softened and hackled.
15. Tow from same.
16. Carded hemp.

Exhibit 4.—Series of hemp and flax, illustrating twine manufacture. A. H. Hart & Company, 90 White street, New York.

17. Kentucky hemp.
18. Softened Kentucky hemp hackled at one end.
19. Hackled Kentucky hemp.
20. Flax grown in Michigan.
21. Hackled American flax.
22. Flax and hemp twine.

Exhibit 5. Samples of flax and hemp treated without chemicals by the Boyce Fiber Company, 280 Broadway, New York City.

23. Flax straw unrotted.
24. Half-broken straw unrotted; no chemicals used.
25. Undressed fiber.
26. Flax, tow, and dressed flax, hackled.
27. Yarn from dressed fiber and linen fabric.
28. Kentucky hemp, stalks roughly broken.
29. Kentucky hemp, dressed line and tow, prepared by Boyce fiber process.

Exhibit 6.—Case containing raw hemp and tarred rope manufactured from it, by the Tucker & Carter Cordage Company, 98 Pine street, New York.

30. Double-dressed Kentucky hemp and four samples of rope.

Exhibit 7.—Miscellaneous specimens of flax.

31. Green flax straw, T. H. Peavey & Co., Minneapolis, Minnesota.
32. Rotted flax straw, J. Kerman, St. Paul, Minnesota.

Exhibit 8. Series of manufactured American flax fiber. From collection of United States Department of Agriculture.

33. Rotted flax straw, broken to show fiber.
34. Once broken and scutched.
35. Tow from the hackle.
36. Dressed line.
37. Tow and roving.
38. Line yarn, dry spun.
39. Tow yarn, wet spun.
40. Upholstering tow.

Exhibit 9.—Linseed oil, meal, and cake. From the Sioux City Linseed-Oil Works, Sioux City, Iowa.

41. Flax seed from T. K. Gwinn, Clinton, Missouri.
42. Ground flax seed (linseed), from the Sioux City Linseed-Oil Works.
43. Oil cake (fine ground).
44. Oil cake (coarse ground).
45. Linseed oil, raw.
46. Linseed oil, boiled.

Exhibit 10.—American flax and hemp, prepared by the Roberts new bleaching process. Donated by Dr. R. R. Roberts, 433 Third Street, Washington, District of Columbia.

47. Prepared fiber from flax grown in Western States.
48. Prepared from rough-cleaned Kentucky hemp.

Subsections D, E, F, and G.—Miscellaneous fibers.

Exhibit 1.—

1 to 4. Ramie and jute stalks and fiber grown in Texas. Sent by Felix Fremerey, Yorktown, Texas.
5. Jute grown in Louisiana. Prepared by Roberts's process.
6. Decorticated jute grown in Texas.
7. Decorticated jute grown in Mississippi.
8. Decorticated jute grown in Louisiana.
9 to 13. Jute and ramie from A. L. Redden, New Orleans, Louisiana.
9. Ramie stalks.
10. Ramie three months old.
11. Spun ramie.
12. Decorticated jute.
13. Jute carpet.
14 and 15. Ramie and jute stalks from Felix Fremery, Yorktown, Texas.
16. Texas-grown ramie fiber. Prepared by the Roberts new bleaching process, Dr. R. R. Roberts, 433 Third street, Washington, District of Columbia.

Exhibit 2.—Mallow fibers.

1 to 6. Collection of United States Department of Agriculture.
1 to 3. Samples of Okra, Abelmoschus esculentus.
4. Swamp rose mallow.—Hibiscus moscheutos.

5. Indian hemp.—Abutilon avicennæ.
6. Cotton stalk fiber.

Exhibit 3.—Leaf fiber. From the collection of the United States Department of Agriculture.

1. Fiber of Agave americana in rough state, San Diego, California, E. Palmer, M. D.
2. Cleaned fiber of Agave mexicana, Mexico.
3. Cleaned fiber of Agave americana, San Diego, California, E. Palmer, M. D.
4. Fiber of Agave sisalana, dressed fiber and rope.
5. Yucca aloifolia, southwestern United States.
6. Yucca baccata, two samples leaf fiber, San Diego, California, E. Palmer, M. D.
7. Coarse fibrous material, roots of Yucca baccata, San Diego, California, E. Palmer, M. D.
8. Prepared fibrous material, roots of Yucca baccata, San Diego, California, E. Palmer, M. D.
9. Yucca angustifolia, leaf and fiber, San Diego, California, Dr. Palmer.
10. Yucca brevifolia, Arizona, Dr. E. Palmer.
11. Yucca filamentosa, leaves in natural state.
12. Yucca filamentosa, prepared fiber.
13. Dasylirion graminifolium, San Antonio, Texas.
14. Palmetto leaves, Jacksonville, Florida.
15. Palmetto fiber, prepared and made into brushes, Jacksonville, Florida.
16. Spanish moss in natural state, Fletcher A. Exley, Savannah, Georgia.
17. Vegetable curled hair, made from Spanish moss.
18. Palmetto fiber, Jacksonville, Florida.
19. Fibrous material from Sabal palmetto.

Exhibit 4.—Miscellaneous fibrous material. Series illustrating the manufacture of matting, bagging, etc., from "Pine fiber," and the preparation of the fiber from the needles or leaves of the Southern pine (*Pinus australis*).

1. One pine "sapling."
2. Pine needles or leaves.
3. Cooked needles or leaves, first process.
4. Rubbed needles or leaves, second process.
5. Carded needles or leaves, third process.
6. Bagging and matting yarns.
7. Surgical dressing material.
8. Pine oil.
9. Waste liquor.
10. "Pine hair."
11. Burlap.
12. Matting.
13. Bagging.
14. Bale of bagging.
15. Bale of matting.

Exhibit 5.—Miscellaneous specimens. Chiefly from collection of U. S. Department of Agriculture.

16 and 17. Apocynum cannabinum fiber, as rudely prepared by Indians for manufacture of mats, nets, etc.

18 and 19. Ascelepias "down," prepared as a fiber, and specimen of yarn made from it. From collection of the United States Department of Agriculture.

20. Sponge cucumber, used for toilet purposes.
21. Home-made horse collar, made from corn husks. Henry Ward, Allen's Station, Georgia.

Section IX.—Tobacco.

Subsection A.—Varieties of leaf.

Contributed by: N. R. Bowman, Lynchburg, Virginia, 9 samples Virginia leaf; Silas Shelburn, Richmond, Virginia, and Frank Winston, Tennessee, 6 samples bright leaf; T. D. Neal, Richmond, Virginia, 5 samples leaf; S. M. Griffin & Co., Richmond, Virginia, 15 samples leaf; J. J. Wilson, Son & Co., Richmond, 10 samples of leaf; Alexander Harthill, Louisville, Kentucky, samples of Green River and Burley, different descriptions; Thornton, Noble & Davis, Richmond, Virginia, 8 samples shipping leaf; Vaughan & Sarvay, Richmond, Virginia, 30 samples Burley, Virginia leaf, and shipping; H. A. Edmondson, South Boston, Virginia, 3 samples manufacturing leaf; P. W. Ferrill, Danville, Virginia, 1 box samples Virginia leaf; L. B. Haas, Hartford, Connecticut, 30 samples Connecticut seed leaf; S. M. Bailey, Amherst County, Virginia, 2 samples shipping leaf; Noblin & Hudson, South Boston, Virginia, 6 samples Virginia leaf; Florida Tobacco Producing Company, 6 samples Florida seed leaf; E. M. Crawford & Son and Thomas H. Hall, New York, samples of New York, Wisconsin, Pennsylvania, and Ohio seed leaf; Maryland Leaf Tobacco Association, 1 frame, 21 samples, Maryland leaf; J. Risque, Campbell County, Virginia, sample of shipping leaf; A. W. Scott, Bedford County, Virginia, sample of shipping leaf.

Subsection B.—Manufactured tobacco.

Winfree, Adams & Loyd, Lynchburg, Virginia, 3 samples of manufactured tobacco, brands, "Arkansas Traveler," "Mississippi Sawyer," and "Adams' Fancy;" L. L. Armistead, Lynchburg, Virginia, samples of smoking tobacco, "Occidental" and "Highlander;" one frame displaying variety of tobacco leaves from Lynchburg, Virginia.

Section X.—Forage Plants and Grasses.

I. Four hundred botanical specimens of grasses and other forage plants in glazed frames.

II. Samples of hay as follows:

Timothy (*Phleum pratense*, L.), C. B. Charles, Bangor, Michigan.
Kentucky blue grass, June grass (*Poa pratensis*, L.), A. A. Crozier, Ames, Iowa.
Hungarian grass (*Setaria italica*, Kth.), (Ohio), Nixon Brewer, Washington, District of Columbia.
Johnson grass (*Sorghum halepense*, Pers.), W. F. Paterson, Fort Worth, Texas.
Bermuda grass (*Cynodon dactylon*, Pers.), Richard Speth, Augusta, Georgia.
Crab grass (*Panicum sanguinale*(L., Richard Speth, Augusta, Georgia.
Texas millet (*Panicum texanum*, Buckley), W. F. Patterson, Fort Worth, Texas.
Texas blue grass (*Poa arachnifera*, Torr.), H. H. Hogan, Ennis, Texas.
Rye grass (*Hordeum pratense*, Huds.), W. H. Warren, Augusta, Georgia.
Wild red top (*Deyeuxia canadensis*, Beauv.), W. J. Beal, Agricultural College, Michigan.
Broom grass (*Andropogon virginicus*, L.), J. W. Cox, Woodville, Georgia.

Blue joint (*Andropogon provincialis*, Lam.), H. H. Kern, Bonner Springs, Kansas.
Paspalum purpurascens, Ell., Dr. L. C. Mattox, Homerville, Georgia.
Upland prairie (*Andropogon provincialis*, Lam., etc.) (Iowa), Nixon Brewer, Washington, District of Columbia.
Upland prairie (*Andropogon scoparius*, Mx., etc.), A. A. Crozier, Ames, Iowa.
Lowland prairie (*Spartina cynosuroides*, Willd.) (Illinois), Nixon Brewer, Washington, District of Columbia.
Southern cane (*Arundinaria macrosperma*, Mx.), J. W. Cox, Woodville, Georgia.
Bluff grass (*Andropogon scoparius*, Mx.), A. A. Crozier, Ames, Iowa.
Salt hay, black grass (*Juncus gerardi*, Loisel), Williams & Rickerson, New York, N. Y.
Salt hay (*Spartina juncea*, Willd.), Williams & Rickerson, New York, New York.
Marsh hay, H. E. Hudson, Hudsonville, Michigan.
Red clover (*Trifolium pratense*, L.) (Maryland) Nixon Brewer, Washington, District of Columbia.
Clover and timothy (*Trifolium pratense*, L., and *Phleum pratense*, L.) (Maryland), Nixon Brewer, Washington, District of Columbia.
Alfalfa, lucern (*Medicago sativa*, L.), C. L. Ingersoll, Fort Collins, Colorado.
Cow pea (*Dolichos sinensis*, L.), J. W. Cox, Woodville, Georgia.
Spanish peanut (*Arachis hypogœa*, L.), Richard Speth, Augusta, Georgia.
Bur clover (*Medicago denticulata*, Willd.), C. R. Orcutt, San Diego, California.
Japan clover (*Lespedeza striata*, H. and A.), S. M. Tracey, Agricultural College, Mississippi, and I. L. Lightfoot, Eutaw, Alabama.
Mexican clover (*Richardsonia scabra*, St. Hil.), Chas. Mohr, Mobile, Alabama.
Alfilaria (*Erodium cicutarium*, L.), C. R. Orcutt, San Diego, California.
Cactus, prickly pear, Nopal (*Opuntia engelmanni*, Salm.), Jas. F. Miller, Gonzales, Texas.

III. The following photographs of implements used in the manufacture of hay, and a number of other hay scenes:
Hay fork, Wesley Redhead, Des Moines, Iowa.
Hay fork, Central Iowa Importing Company, Ames, Iowa.
Mower, Agricultural College, Ames, Iowa.
Loader, Agricultural College, Ames, Iowa.
Loader (Hawkeye), Chambers, Bering, Quinlan Company, Decatur, Illinois.
Rake, Agricultural College, Ames, Iowa.
Stacker (Dain), Des Moines, Iowa.
Stacker (Acme), Des Moines, Iowa.
Hay press (Champion), Des Moines, Iowa.
Hay press (Dederick), C. B. Charles, Bangor, Michigan.

IV. Samples of ensilage from the following sources:
Agricultural College, Ames, Iowa.
Maryland Experiment Station.
College Station, Maryland.
Pennsylvania Experiment Station, State College, Pennsylvania.

Section XI.—Forestry.

Subsection A.—Forest botany.

Exhibit 1.—Fifteen maps showing distribution of forest growth and of genera and species of forest trees in North America. From the Tenth Census, United States, 1880.

1. Map showing the natural divisions of North American forests.
2. Map showing the position of forest, prairie, and treeless regions of North America.
3 to 15. Maps showing the distribution of various genera and species of forest trees.

Exhibit 2.—16 to 369. Collection of wood sections and herbarium specimens representing 125 species of the economically important timber trees of the United States, botanically arranged on 13 panels, with explanatory labels, showing botanical distribution and giving descriptive notes for each species.—(121 wood sections and labels and 112 cases of botanical specimens.) Prepared by B. E. Fernow, chief of Forestry Division, United States Department of Agriculture.

Panels 1 and 2: Twenty-one species of pines and 1 species of torreya.
Panels 3 and 4: Twenty-four species of Coniferæ other than pines.
Panels 5, 6, and 7: Fifteen species of Quercus and 3 other Cupuliferæ; 7 species of Carya and 5 other Juglandaceæ; 1 species of Ebenaceæ.
Panels 8, 9, and 10: Twenty-seven species of the families Magnoliaceæ, Tiliaceæ, Sapindaceæ, Cornaceæ, Oleaceæ, Bignoniaceæ.
Panels 11, 12, and 13: Twenty-one species of families Ilicineæ, Lauraceæ, Urticaceæ, Platanaceæ, Betulaceæ, Salicaceæ.

Credit due for label base to Morris K. Jessup, president American Museum of Natural History, New York; for botanical specimens to Dr. N. L. Britton, Columbia University, New York, and Dr. Charles Mohr, Mobile, Alabama.

Exhibit 3.—Nos. 370 to 449. "Michaux's Sylva," being 240 colored plates, representing the forest flora of the United States, as described by Andre F. Michaux, father and son; 80 mats in swinging frames. Furnished by the Massachusetts Society for the Promotion of Agriculture, trustees of the Michaux fund.

Exhibit 4.—Views of characteristic trees.

450 to 490. Bromide enlargements of photographs of forest trees from the Atlantic region. Credit due to Prof. J. T. Rothrock, Philadelphia, Pennsylvania; Mr. H. Brooks, Boston, Massachusetts.

492 to 499. Photographs (20 by 24 inches) of characteristic California trees, framed. Furnished by Mr. J. W. Taber, San Francisco, California.

Exhibit 5.—Anatomy and structure of woods.

500. Veneer sections of 16 species of wood, radial, tangential, and transverse cuts, arranged under mica in one swinging frame. Furnished by Charles W. Spurr Company, Boston, Massachusetts.

501. Veneer sections, radial, tangential, and transverse, of 25 species in 27 sheets, with text, in book form. Furnished by Romeyn B. Hough, Lowville, New York.

502 to 521. Sixty photomicrographs of 21 woods, in radial, tangential, and transverse sections; 20 mats in 6 swinging frames. Credit due for microscopic sections to J. L. Zabriskie, Flatbush, New York, and for photomicrography to Thomas W. Smillie, photographer, National Museum, Washington, District of Columbia.

Exhibit 6.—Peculiarities of forest growth, from the collection of the Department of Agriculture.

522 and 523. Cypress knees.
524 and 525. Sections of grapevine.
526. Tillandsia moss.

Subsection B.—Forest culture.

Exhibit 7. 527.—Wall map of the United States, showing in five shades of color the ratio of woodland to total area, and by markings the location of densest forest growth in each State (17 by 12 feet). Prepared by B. E. Fernow, chief of Forestry Division. Map work by W. L. Nicholson, Washington, District of Columbia.

Exhibit 8.—528. Collection of 100 species of tree seeds in bottles. Prepared by B. E. Fernow, chief of Forestry Division.

Exhibit 9.—529. Model of tree-planting machine. Furnished by B. E. Fernow, forest engineer, Washington, District of Columbia.

Exhibit 10.—530 to 575. Transverse sections of 46 trees from various localities, showing rate of growth; 46 sets of 5 sections from each tree, taken at different heights, mounted together. Prepared by B. E. Fernow, chief of Forestry Division. Credit due for sections to Prof. C. S. Sargent, director of the Arnold Arboretum, Brookline, Massachusetts; to Prof. W. J. Beal, Agricultural College, Michigan; to Prof. J. T. Burrill, Agricultural College, Illinois; to Geo. W. Nettleton, superintendent of the Kansas, Fort Scott and Gulf Railroad, Kansas City. Missouri.

Exhibit 11.—576. Plan of the Arnold Arboretum, Jamaica Plain, Massachusetts. Furnished by Prof. C. S. Sargent, Brookline, Massachusetts.

Subsection C.—Forest utilization.

Exhibit 12.—Slabs of wood of special dimensions. From collections of the United States Department of Agriculture.

577. Plank of redwood (*Sequoia*) framed.
578. Slab of white wood (*Liriodendron*).
579. Plank of white pine (*Pinus strobus*). Furnished by Paine Lumber Company, Oshkosh, Wisconsin.
580. Plank of cypress (*Taxodium*).
581. Slab of black walnut (*Juglans nigra*).
582. Slab of black cherry (*Prunus serotina*).
583. Slab of birch (*Betula lenta*).

Exhibit 13.—Furniture woods. From collections of United States Department of Agriculture.

584. Panel of white ash (*Fraxinus americana*).
585. Panel of white wood (*Liriodendron*).
586. Panel of white oak (*Quercus alba*).
587. Panel of black walnut (*Juglans nigra*).

Exhibit 14.—Curly and figured woods. From collections of United States Department of Agriculture.

588. Panel of curly yellow pine (*Pinus palustris*).
589. Panel of curly maple (*Acer saccharinum*), framed.
590. Panel of figured yellow pine (*Pinus palustris*).
591. Panel of curly black walnut (*Juglans nigra*).

Exhibit 15.—Veneer sections.

592 and 593. Two frames of veneers, used for wall-papering and parqueterie.

594. One frame of veneer sections, adapted to use for business, visiting, Christmas cards, etc. Furnished by Romeyn B. Hough, Lowville, New York.

Exhibit 16.—Methods of lumbering.

595. One redwood frame, containing 32 photographic views, illustrating methods of lumbering in California redwoods. Donated by I. E. Thayer, San Francisco, California.
596. Portfolio containing 25 photographic views. illustrating methods of lumbering and forest scenes in the California redwoods. Donated by the Humboldt Lumber Manufacturing Association, Eureka, California.
597. One yellow pine frame, with photographic views, illustrating methods of lumbering in the southern pineries. Donated by Lutcher & Moore, Orange, Texas.
598. Lumbering scenes in the white pine forests of the Northwest; photographic views in one frame.

Exhibit 17.—Tools, utensils, and machinery used in lumbering and logging.

599. Model of a logging sleigh, furnished by Alexander Hurtubise, East Saginaw, Michigan.
600. Ring peavy.
601. Socket peavy.
602. Cant hook.
603. Swamp hook.
604. Loading block.
605. Grab hook.
606. Round hook.

607 to 609. Cold shuts.

610. Flat skidding tongs.
611. Octagon skidding tongs.
612. Boot calks.

(Furnished by Morley Brothers, East Saginaw, Michigan.)

613. Model of steam logger. A machine making its own ice-road in the woods, and hauling a train of sleighs loaded with logs at the same time. Furnished by Chandler & Glover, Chicago, Illinois.

Exhibit 18.—Turpentine orcharding in the South. (Credit due to Chas. Mohr, Mobile, Alabama.)

614. Turpentine log, showing box and chip.
615. Open hacker.
616. Closed hacker.
617. Dipper.
618. Rosin in eleven qualities.

Exhibit 19.—Collection of tan barks and tan extracts, furnished by Tiffany Chemical Company, New York, N. Y.

619. Monster slab hemlock bark, 8 by 12 feet, framed, from Fayerweather & Ladew, New York, N. Y.
620. Slab of white oak bark.
621. Slab of red oak bark.
622. Slab of chestnut oak ba
623. Slab of black oak bark.
624. Slab of hemlock bark.
625. Sample of Canaigre root.

626. Sample of Virginia sumac (leaves).
627. Sample of Virginia sumac (ground).
628. Sample of sumac extract.
629. Sample of sumac extract (extra).
630. Sample of chestnut oak bark extract.
631. Sample of quercitron bark extract.
632. Sample of quercitron bark extract (extra).
633. Sample of liquid hemlock bark extract.
634. Sample of solid hemlock bark extract.
635. Sample of refined hemlock bark extract.

Exhibit 20.—Processes of manufacturing indurated fiber ware, illustrated by materials in different stages of manufacture. (See Special Exhibit of these manufactures in another place.)

636. Spruce log.
637. Ground pulp.
638. Mixed pulp.
639. Pail, first stage.
640. Pail, trimmed down.
641. Pail, polished ready for treatment.
642. First treatment.
643. Second treatment.
644. Third treatment.
645. Finished pail.
646. Tub of indurated ware.

Exhibit 21.—

647. Autumn tints of North American forest. Frame with view showing building of United States Department of Agriculture. (Credit due Miss Juliet King, Washington, District of Columbia.)

DIVISION 4.—EDUCATIONAL EXHIBITS.

SECTION XII.—ECONOMIC ORNITHOLOGY AND MAMMALOGY.

SECTION XIII.—FOOD ADULTERATIONS.

(The lists of Sections XII and XIII are included in the reports on those sections.)

SECTION XIV.—FUNGOUS DISEASES OF PLANTS.

Description to accompany photographs of peach yellows.

1. Healthy terminal peach shoot from Delaware. Photographed August 20, 1888. Reduced to about one-half natural size, *i. e.*, larger left-hand leaf was 2 inches broad and 8 inches long. Growth strictly comparable with 2.

2. Peach yellows; diseased terminal shoots from a Delaware orchard. Photographed September 27, 1887. Reduced to about one-half natural size. The growth upward from *a* and *a'* took place during one season. Many small branches were cut from the center to give a clearer view. Strictly comparable with 1.

3. Healthy terminal peach shoots from Michigan; winter appearance. Photographed March, 1888. Reduced to about one-tenth natural size. Strictly comparable with 4.

4. Peach yellows; diseased terminal shoots from a Michigan orchard; winter appearance. Photographed May, 1888. Enlarged slightly, the actual length of the main axis in right-hand shoot being 10 inches. Shoots entirely dead. Comparable with 3.

5. Delaware peach tree in second year of yellows. Photographed August 27, 1888. Tree seven years old and about 16 feet in height; foliage much dwarfed and yellow; barren; base of limbs grown up with diseased shoots. Tree stands near healthy trees and was much less affected the previous year.

6. Delaware peach orchard ruined by yellows. Photographed August 28, 1888. Trees eight years old; set 20 feet apart; third and fourth year of disease. The tree in the foreground is entirely dead. The wiry growths on the limbs are very characteristic and are often the last indication of vitality.

7. Maryland peach orchard ruined by yellows. Photographed November 7, 1888. Trees eight years old; 20 feet apart; diseased three to five years and only recently cut down; forms part of a large orchard, nearly all of which is badly diseased. Photographs 5, 6, and 7 show three stages of the disease. A stage earlier than 5, and characterized by the appearance of red-spotted, prematurely ripened fruit, can not be shown satisfactorily by photographs.

(A map showing distribution of disease in United States accompanies these photographs.)

SECTION XV.—AGRICULTURAL STATISTICS.

Diagrams.

1. Wheat distribution in the United States. Crops of 1859, 1879, 1887. Scale: 1 square inch = 10,000,000 bushels.
2. Corn distribution in the United States. Crops of 1859, 1879, 1887.
3. Oats distribution in the United States. Crops of 1859, 1879, 1887. Scale: 1 square inch = 10,000,000 bushels.
4. Cotton and tobacco distribution in the United States. Crops of 1859, 1879, 1886. Scale: Cotton, 1 square inch = 150,000 bales; tobacco, 1 square inch = 10,000,000 pounds.
5. Product and export of corn in millions of bushels.
6. Effect of varying product on price of corn.
7. Acreage and product of wheat. Scale area: Each square = 100,000 acres. Product: Each car = 25,000,000 bushels.
8. Product and export of wheat; 1849, 1859, 1869, 1879, 1887. Scale: Each square = 350,000 bushels.
9. Progress of cereal production; 1849, 1859, 1869, 1879, 1888.
10. Produce per capita of cereals in Europe and the United States.
11. Increase of farm animals, indicated in millions.
12. Export of hog products, in millions of pounds.
13. Exports of beef. Fresh beef, 1877–1888. Value of beef products, 1855, 1865, 1875, 1885.
14. Product and export of cotton; 1841–1887, in millions of pounds.
15. Increase of values of farm products, 1859–1887.

16. Value of products of agriculture and proportion exported, 1886–1887.
17. Average wages of farm labor, in dollars per month.
18. Foreign trade of the United States, 1887–1888. Scale: Each square = $500,000.
19. Dietaries of different peoples.
20. Increase of railroad mileage in the United States.

SECTION XVI.—AGRICULTURAL SCIENCE AND EDUCATION.

Name of exhibitor.	Address of exhibitor.	Article.	List No.	Description.
Alabama Experiment Station.	Auburn, Ala	Photograph.	1	Director's house.
Do	...do	...do	2	Students' laboratory.
Do	...do	...do	3	Do.
Do	...do	...do	4	Office on farm.
Do	...do	...do	5	Dairy.
Do	...do	...do	6	Barn, engine, and gin.
Do	...do	...do	7	Chemical laboratory (exterior).
Do	...do	...do	8	Do.
Do	...do	...do	9	Station chemical laboratory.
Do	...do	...do	10	Balances in chemical laboratory.
Do	...do	...do	11	Chemical lecture room.
Do	...do	...do	12	Do.
Do	...do	...do	13	Botanical laboratory.
Do	...do	...do	14	Table in botanical laboratory.
Do	...do	...do	15	Director's house and conservatory.
Do	...do	...do	16	Jersey bull and cattle barn.
Do	...do	...do	17	Jersey cows, bull, and cattle barn.
Do	...do	Wood	18	Polytechnic institute.
Arkansas Industrial University.	Fayetteville, Ark	Photograph.	19	Main building of the Arkansas Industrial University.
Do	...do	...do	20	Male dormitory.
Colorado Agricultural College.	Fort Collins, Colo.	...do	21	College building.
Do	...do	...do	22	Department of physics and engineering.
Do	...do	...do	23	Department of mechanics and drawing.
Do	...do	...do	24	Chemical laboratory.
Do	...do	...do	25	The conservatory, department of botany and horticulture.
Wesleyan University.	Middletown, Conn.	...do	26	Orange Judd Hall of Natural Science. Seat of first agricultural experiment station in America.
Do	...do	...do	27	Orange Judd Hall of Natural Science. Private laboratory of professor of chemistry.
Do	...do	...do	28	Do.
Connecticut Agricultural School and Station.	Storrs, Conn	...do	29	Main building of the Storrs Agricultural School, used for dormitory, boarding-house, and class rooms. In the extreme rear at left is the chemical laboratory.
Do	...do	...do	30	Chemical laboratory.
Do	...do	...do	31	Chemical laboratory, with office of experiment station at right.
Do	...do	...do	32	Office of experiment station.
Do	...do	...do	33	Farm house and barn of school (duplicate).
Do	...do	...do	34	Barn of school.
Do	...do	...do	35	Group of officers and students of school in front of chemical laboratory.
Delaware College and Experiment Station.	Newark, Del	...do	36	Delaware College and Delaware College Agricultural Experiment Station.
Do	...do	...do	37	Delaware College Agricultural Experiment Station.
University of Illinois.	Urbana, Ill	...do	38	Main building.
Do	...do	...do	39	Chemical building.
Do	...do	...do	40	Mechanical building.
Do	...do	...do	41	North barn, experiment station.
Do	...do	...do	42	South barn, agricultural farm.
Do	...do	...do	43	Residence of professor of agriculture.
Do	...do	...do	44	Agricultural and horticultural laboratory, experiment station.
Do	...do	...do	45	Veterinary house and clinic.
Do	...do	...do	46	Museum of Natural History.
Do	...do	...do	47	Library.
Do	...do	...do	48	Art gallery.
Do	...do	...do	49	Museum of Industrial Art. (The central figure is a model of a design for a memorial monument to Victor Emanuel, first King of United Italy. It was exhibited in a competition at Rome and received from the art committee second place among nearly three hundred designs. It was presented to the university by the artist, Henry Lord Gay, of Chicago.)

SECTION XVI.—AGRICULTURAL SCIENCE AND EDUCATION—Continued.

Name of exhibitor.	Address of exhibitor.	Article.	List No.	Description.
University of Illinois.	Urbana, Ill	Photograph.	50	Chapel at morning prayers.
Do	...do	...do	51	Drawing-room, School of Art and Design. Prof. Peter Roos.
Do	...do	...do	52	Drawing room, mathematical. Prof. Arthur N. Talbot.
Do	...do	...do	53	Drawing room, school of architecture. Prof. N. C. Ricker.
Do	...do	...do	54	Drawing room, school of mechanical engineering. Prof. A. T. Woods.
Do	...do	...do	55	Machine shop, school of mechanical engineering.
Do	...do	...do	56	Carpenter shop, school of architecture.
Do	...do	...do	57	Laboratory, school of chemistry. Assistant Prof. A. G. Manns.
Do	...do	...do	58	Laboratory, experiment station.
Do	...do	...do	59	Laboratory, zoölogical. Prof. S. A. Forbes.
Do	...do	...do	60	Laboratory, State laboratory of natural history. Prof. Forbes.
Do	...do	...do	61	Laboratory, botanical. Prof. T. J. Burrill.
Do	...do	...do	62	Laboratory, biological. Prof. T. J. Burrill (bacteriological).
Do	...do	...do	63	Military company, school of military science.
Purdue University and Experiment Station.	Lafayette, Ind	...do	64	Plan of campus and farm of Purdue University.
Do	...do	...do	65	Ladies' hall, chemical and physical laboratory, University Hall, and men's dormitory.
Do	...do	...do	66	Engine house, University Hall, men's dormitory, military hall, and mechanical laboratory.
Do	...do	...do	67	United States experiment station.
Do	...do	...do	68	Plans of United States experiment station.
Do	...do	...do	69	Detail plan, chemical rooms, United States experiment station.
Do	...do	...do	70	Detail plan, botanical rooms, United States experiment station.
Do	...do	...do	71	Plans of mechanical laboratory.
Do	...do	...do	72	Testing laboratory, hall, foundry, drawing room.
Do	...do	...do	73	Wood room, engine room, tool room.
Do	...do	...do	74	Machine room, forge room.
Do	...do	...do	75	Souvenir Purdue University. Industrial exhibit, 1888.
Kansas Agricultural College.	Manhattan, Kans.	...do	76	Natural history building.
Do	...do	...do	77	Chemical laboratory.
Do	...do	...do	78	Mechanics' hall.
Do	...do	...do	79	Horticultural department building.
Do	...do	...do	80	Residence, professor of agriculture.
Do	...do	...do	81	Experiment station, horticultural department.
Do	...do	...do	82	College barn.
Do	...do	...do	83	Part of college yard.
Do	...do	...do	84	Chemical department, experiment station.
Do	...do	...do	85	Residence of president of college.
Do	...do	...do	86	Telegraph department.
Do	...do	...do	87	Main college building.
Do	...do	...do	88	Woodwork shop.
Do	...do	...do	89	Do.
Do	...do	...do	90	Sewing room.
Do	...do	...do	91	Pines in horticultural nursery.
Do	...do	...do	92	View in greenhouse.
Do	...do	...do	93	Interior of barn.
Do	...do	...do	94	Do.
Do	...do	...do	95	Library.
Do	...do	...do	96	Kitchen, department of domestic economy.
Do	...do	...do	97	Printing department.
Do	...do	...do	98	Chemical department, practice laboratory.
Do	...do	...do	98½	Drawing room.
Do	...do	...do	99	Chart of grounds.
Maine State College of Agriculture and Mechanic Arts.	Orono, Me	...do	100	Principal buildings, Maine State College of Agriculture and Mechanic Arts.
Do	...do	...do	101	Wingate Hall.

SECTION XVI. -AGRICULTURAL SCIENCE AND EDUCATION—Continued.

Name of exhibitor.	Address of exhibitor.	Article.	List No.	Description.
Maine State College of Agriculture and Mechanic Arts	Orono, Me	Photograph.	102	Mechanical shop.
Do	do	do	103	Oak Hall (dormitory) and boarding-house.
Do	do	do	104	Coburn Hall.
Do	do	do	105	Laboratory of Maine State College.
Massachusetts Agricultural College.	Amherst, Mass	do	106	Botanic museum, containing lecture rooms, laboratory, and museum, in which are large collections of pressed plants, specimens of woods, and models of fruit.
Do	do	do	107	Views of the plant houses, the gift of private individuals. (Four views.)
Do	do	do	108	Do.
Do	do	do	109	Do.
Do	do	do	110	Do.
Do	do	do	111	Barn with accommodation for 70 head of cattle below and space for 250 tons of hay above.
Do	do	do	112	Laboratory building used in common by the departments of chemistry and physics, the upper story being a hall devoted to a museum of agricultural implements.
Do	do	do	113	North dormitory, erected in 1869–'70, containing accommodations for 64 students. The same general arrangement obtains of study and two bedrooms in each suite.
Do	do	do	114	Agricultural Hall, or south dormitory, erected in 1886–'87. The tower forms the dividing line between dormitory and lecture rooms. The former contains 18 suites of rooms for 36 occupants; each suit has three rooms, a study room and two bed rooms. All the study rooms face to the south and are heated by steam, though each is furnished with a fireplace for better ventilation. The whole east front of the building is devoted to lecture rooms.
Do	do	do	115	Interior view of drill hall fitted up for the exercises of commencement week before the chapel-library building had been erected.
Do	do	do	116	Exterior of drill hall, erected at a cost of $6,500. Instruction in the theory and art of war as well as in the school of the soldier given in this building. Drill hall 135 by 63 feet
Do	do	do	117	Chapel-library building of granite; erected in 1885 at a cost of $31,000; audience room above capable of seating 600 persons; library below with shelving for 20,000 volumes.
Do	do	do	118	Interior view of lecture room in department of physics, laboratory building.
Do	do	do	119	Interior view of stone chapel; audience room used for commencement exercises; seating capacity, about 600.
Do	do	Diagram	120	Station building, ground plan; A, Laboratory building, ground plan; B, Laboratory building, second floor
Do	do	do	121	Plan of west wing of laboratory.
Do	do	do	122	Plan of farm buildings.
Do	do	do	123	Stable, piggery, and sheep shed.
Do	do	do	124	Map of land leased to the Massachusetts Experiment Station from the Agricultural College Farm west of the highway.
Do	do	do	125	Map of land leased to the Massachusetts Experiment Station from the Agricultural College Farm east of the highway.
Massachusetts State Experiment Station.	do	Photograph.	126	Building.
Do	do	do	127	Barns.
Do	do	do	128	Farm house and barn.

SECTION XVI.—AGRICULTURAL SCIENCE AND EDUCATION—Continued.

Name of exhibitor.	Address of exhibitor.	Article.	List No.	Description.
Michigan Agricultural College.	Agricultural College, Mich.	Photograph.	129	Wells Hall, students' dormitory.
Do	....do	....do	130	Williams Hall, students' dormitory.
Do	....do	....do	131	Abbot Hall, students' dormitory.
Do	....do	....do	132	Howard Terrace, for minor professors and assistants.
Do	....do	....do	133	Chemical laboratory, front view.
Do	....do	....do	134	Chemical laboratory, rear view.
Do	....do	....do	135	Horticultural laboratory, front view.
Do	....do	....do	136	Horticultural laboratory, rear view.
Do	....do	....do	137	Garden.
Do	....do	....do	138	Botanical laboratory, northwest view.
Do	....do	....do	139	Botanical laboratory, from wild garden.
Do	....do	....do	140	Botanical laboratory, north view, with flagstaff.
Do	....do	....do	141	Botanical laboratory, from wild garden.
Do	....do	....do	142	Veterinary laboratory, front view.
Do	....do	....do	143	Veterinary laboratory, with landscape.
Do	....do	....do	144	Mechanical laboratory, outside.
Do	....do	....do	145	Mechanical laboratory, iron shop.
Do	....do	....do	146	Boiler house, outside.
Do	....do	....do	147	Pumps, inside.
Do	....do	....do	148	Old college hall, chapel and class room.
Do	....do	....do	149	Old college hall, with shrub.
Do	....do	....do	150	Library and museum.
Do	....do	....do	151	Library and old college hall.
Do	....do	....do	152	Farm house.
Do	....do	....do	153	Farm house in landscape.
Do	....do	....do	154	Armory and botanical laboratory, landscape.
Do	....do	....do	155	Portion of greenhouse and flower beds.
Do	....do	....do	156	Landscape—Williams Hall.
Do	....do	....do	157	Botanical wild garden.
Do	....do	....do	158	Do.
Do	....do	....do	159	Cedar River.
Do	....do	....do	160	Rustic bridge.
Do	....do	....do	161	Do.
Do	....do	....do	162	Landscape—Tower of Williams Hall.
Do	....do	....do	163	Landscape.
Do	....do	....do	164	Do.
Do	....do	....do	165	Do.
Do	....do	....do	166	Porch of president's house and shrubbery.
New Hampshire College of Agriculture and Mechanic Arts	Hanover, N. H.	....do	167	View of part of State Farm and college buildings.
Do	....do	....do	168	View from Culver Hall.
Do	....do	....do	169	Conant Hall.
Do	....do	....do	170	Culver Hall.
Do	....do	....do	171	Workshop.
Do	....do	....do	172	Agricultural buildings.
Do	....do	....do	173	Experiment-station building.
Do	....do	....do	174	Experiment-station microscopical laboratory.
Do	....do	....do	175	View of State farm and buildings.
Do	....do	....do	176	View of portion of State farm.
Do	....do	....do	177	Ensilage cutting.
Do	....do	....do	178	Threshing.
Do	....do	....do	179	Ayrshire cow.
Do	....do	....do	180	Do.
Do	....do	....do	181	Do.
Do	....do	....do	182	Holstein cows.
Rutgers College	New Brunswick, N. J.	....do	183	College buildings.
South Carolina Experiment Station.	Columbia, S. C	....do	184	Director of station, J. M. McBryde, PH. D.
Do	....do	....do	185	Director's office.
Do	....do	....do	186	Science hall of the University of South Carolina; offices and laboratories of the experiment station.
Do	....do	....do	187	Chemical laboratory.
Do	....do	....do	188	Chemical laboratory; soil and seed analyses.
Do	....do	....do	189	Botanical and entomological laboratory,
Do	....do	....do	190	Bacteriological laboratory.
University of Tennessee.	Knoxville, Tenn	....do	191	State agricultural and mechanical college; buildings and students.
Do	....do	....do	192	Agricultural experiment station and Tennessee River.
Virginia Experiment station.	Blacksburg, Va	....do	193	Map of Virginia Agricultural and Mechanical College experiment station.

SECTION XVI.—AGRICULTURAL SCIENCE AND EDUCATION—Continued.

Name of exhibitor.	Address of exhibitor.	Article.	List No.	Description.
Virginia Experiment station.	Blacksburg, Va...	Photograph.	194	Plan of station building; first floor.
Do	....do	....do	195	Front elevation of station building.
Do	....do	....do	196	Plan of experiment grounds.
Do	....do	....do	197	Plan of experiment station barns.
Do	....do	....do	198	Holstein heifer.
Do	....do	....do	199	Shorthorn heifer, Miss Morton, aged 26 months, weight 1,110 pounds.
Do	....do	....do	200	Group of Shorthorn steers.
Do	....do	....do	201	Shorthorn bull, Sharon Duke 16th, head of herd, aged 37 months, weight 1,810 pounds. Shorthorn, "Red Rose," of Saltville, age 30 months, weight 1,230 pounds.
Do	....do	....do	202	Registered Holstein cow and bull calf.
Do	....do	....do	203	Jersey cow, "Virginia B ossom," aged 27 months.

APPENDIX V.

LIST OF AWARDS MADE IN THE UNITED STATES AGRICULTURAL EXHIBIT.

[Those with an asterisk (*) being for collaboration in preparing the exhibit.]

CLASS 42.—FORESTRY.

Gold medals.—United States Department of Agriculture, Washington, D. C. (collective exhibit); Korbel, F., & Brothers (California redwood lumber and doors), San Francisco, California; Jackson, Arthur C. (raw and manufactured products, etc.), Sanford, Florida.

Silver medals.—Massachusetts Society for the Promotion of Agriculture, Boston, Massachusetts; Northern Pacific Railroad Company, New York City; Rothrock, J. P. (photographs of characteristic forest trees), Philadelphia, Pennsylvania; Sargent, Charles S. (sections of trees), Jamaica Plains, Massachusetts; Hough, Romeyn B. (veneer sections), Lowville, New York.

Bronze medals.—Cordley & Hayes (induated fiber ware, kitchen utensils), etc., New York City.

Honorable mention.—Brooks, Henry (photographs of forest trees), Boston, Massachusetts; Fayerweather & Ladew (hemlock bark), New York; Tiffany Chemical Company (samples of tan bark and tan extracts), New York City.

CLASS 44.—AGRICULTURAL PRODUCTS NOT USED FOR FOOD.

Grand prizes.—United States Department of Agriculture, Washington, D. C. (collective exhibits, fibers, tobacco, etc.).

Gold medals.—Cotton Oil Product Company (cotton-seed-oil lard, etc.), New York City; Dutton, H. F., & Co., Haas, L. B. (tobacco), Hartford, Connecticut; Southern Cotton Seed Company, New York City; Vaughan & Sarvay (tobacco), Richmond, Virginia.

Silver medals.—Allen & Ginter (tobacco), Richmond, Virginia; Bowman, N. R. (tobacco), Lynchburg, Virginia; Boyce, S. S. (hemp and flax from dry fiber), New York City; Clark, Washington A. (sea island cotton), Columbia, South Carolina; Harthill, Alex. (tobacco), Louisville, Kentucky; Hinson, W. Q. (sea island cotton), James Island, South Carolina; Kimball, W. A., & Co. (tobacco), Rochester, New York; Roberts, Dr. R. R. (American flax and hemp), Washington, District of Columbia; Sioux City Linseed Oil Works (linseed oil, meal, and cake), Sioux City, Iowa; J. J. Wilson, Son & Co. (tobacco), Richmond, Virginia; C. V. Riley, Washington (silk from osage orange), District of Columbia.

Bronze medals.—Florida Tobacco Producing Company; Griffin, S. M., & Co. (tobacco), Richmond, Virginia; Nye, William (Oils), New Bedford, Massachusetts; Straiton & Storm, (tobacco), New York City; Stubbs, Prof. W. C. (samples of cotton in seed), Baton Rouge, Louisiana; Thornton, Noble & Davis (tobacco), Richmond, Virginia; *A. McDonald, Lynchburg, Virginia; *Dr. George Vasey, Washington, District of Columbia.

Honorable mention.—Crawford, E. M., & Son (tobacco), New York City; Hall, Thomas (tobacco), New York City; Florida's collective exhibition; Fremery, Felix (native-grown jute, ramie and ramie seed), Yorktown, Texas; Jackson, Arthur C., Sanford, Florida; Neal, T. D., Richmond, Virginia; Noblin & Hudson, South Boston, Virginia; Shelborn, Silas (tobacco), Richmond, Virginia; Winston, Frank (tobacco), Tennessee.

CLASS 50.—APPARATUS AND METHODS USED IN AGRICULTURAL AND FOOD INDUSTRIES.

Gold medals.—United States Department of Agriculture, Washington, District of Columbia (model of silo, creamery, etc.)

CLASS 67.—CEREALS; FARINACEOUS PRODUCTS, WITH THEIR DERIVATIVES.

Grand prizes.—United States Department of Agriculture, Washington, District of Columbia (collective exhibit).

Gold medals.—*Wiley, H. W., United States Department of Agriculture (sorghum), Washington, District of Columbia; Northern Pacific Railroad; Pillsbury, C. A., & Co. (flour in the various stages of manufacture), Minneapolis, Minnesota; *George W. Hill, Washington, District of Columbia; Board of Trade (samples illustrating various grades of official inspection), Chicago, Illinois; Glen Cove Manufacturing Company (samples of "maizena," grape sugar, and glucose), New York City.

Silver medals.—Commissioner of agriculture for South Carolina; Schumacher, T., & Co. (farinaceous products), Akron, Ohio.

Bronze medals.—Street & Co.

Honorable mention.—Mansfield, Miss. (popped corn), Washington, District of Columbia.

CLASS 69.—FAT SUBSTANCES USED FOR FOOD; MILK PRODUCTS AND EGGS.

Gold medals.—Green Mountain Stock Farm. Michener, J. H., & Co. (lard), Philadelphia, Pennslyvania.

Silver medals.—Salmon, D. E., Chief of Bureau of Animal Industry, United States Department of Agriculture, Washington, District of Columbia; Armour & Co. (lard), Chicago, Illinois; Cassard, G., & Co. (lard), Baltimore, Maryland; Morell & Co., Southern Cotton Seed Oil Co. (refined cotton seed oil), New York.

Bronze medal.—Hooper, Geo. F. (olive oil), Sonoma, California.

Honorable mention.—Swift & Co. (lard), Chicago, Illinois; Luidi Bagnoli.

CLASSES 70-71.—PRESERVED MEATS, FISH, VEGETABLES, AND FRUIT.

Gold medals.—Armour & Co. (canned, salted, and packed meats, etc.), Chicago, Illinois; Cassard, G., & Co. (dried, salted and smoked meats), Baltimore, Maryland; Curtice Brothers (canned meats), Rochester, New York; Michener, J. H., & Co. (dried, salted, and smoked meats), Philadelphia, Pennsylvania; Morris & Co. (canned meats), Chicago, Illinois; Swift & Co. (salted, packed, dried, and smoked meats), Chicago, Illinois.

Silver medals.—United States Department of Agriculture, Washington, District of Columbia; *Van Deman, H. E.; Division of Pomology, United States Department of Agriculture, Washington, District of Columbia; Brougham, Geo. (extracts of meat, canned soups), Chicago, Illinois; Franco-American Soup Company (canned soups), New York City; Cowdrey, E. I., & Co. (canned meats), Boston, Massachusetts; Numsen, William, & Sons (pineapples, peaches, plums, and berries, canned vegetables), Baltimore, Maryland; Pacific Orchard Cannery; Rosa, John J. (evaporated peaches), Milford, Delaware; Van Nostrand & Co; *M. G. Kern, St. Louis, Missouri.

Bronze medals.—Florida State Horticultural Society (citrus fruits); Erie Preserving Company (canned succotash, sweet corn, and tomatoes), Buffalo, New York; Griffin Canning Company (canned tomatoes), Griffin, Georgia; Huckins, J. H. W., & Co. (canned soups), Boston, Massachusetts; Humbert, Henry, & Co. (extracts of meat), New York City; Mallory, E. B., & Co. (canned tomatoes, corn, and peas, peaches) Baltimore, Maryland; Martin, Wagner & Co. (canned tomatoes, corn, etc.), Baltimore, Maryland; Myer, Thomas J., & Co. (canned vegetables, fruits, and berries), Baltimore, Maryland; Perry, F. H., & Co. (canned tomatoes, asparagus, beans and corn), Providence, Rhode Island; Sears & Nicholl (twelve cans of corn;

canned peaches), Chillicothe, Ohio; Winterport Packing Company (canned sweet corn), Winterport, Maine.

Honorable mention.—Brown, Arthur (nuts), Bagdad, Santa Rosa County, Florida; Clagett, F. (canned corn, etc.), Upper Marlboro, Maryland; Hooper, Geo. F. (nuts, prunes, olives), Sonoma, California: Kimball, Frank A. (citrus fruits), National City, California; Kennon, Gray & Co. (canned vegetables), Sublett Tavern, Pennsylvania; Orestott, Henry (raisins), Placer County, California; Rixord, G. P. (berries and nuts), San Francisco, California.

CLASS 73.—FERMENTED DRINKS.

Section I.—Wines.

Gold medals.—Chauche, A, G., Livermore, Alameda County, California; Wetmore, Charles A., Livermore, Alameda County, California; Megliavalla, G., Napa, California.

Silver medals.—Beck, Adolphe, San Francisco, California; Beringer Brothers, St. Helena, Napa County, California; Greenbaum, Alfred, San Francisco, California; Haraszthy, Arpad, & Co., San Francisco, California; Hagner, Henry, Cedar Knoll Vineyards, Napa County, California; Hooper, George F., Sobre Vista Vineyards, Napa County, California; Kohler & Frohling, San Francisco, California; Monticello Wine Company, Charlottesville, Virginia; New Urbana Wine Company, Hammondsport, New York; Pleasant Valley Wine Company, Rheims, Steuben County, New York; Schilling, C. & Co., San Francisco, California; Stone Hill Wine Company, Hermann, Missouri; Wineberger, Mrs. J. C., St. Helena, California.

Bronze medals.—American Wine Company, St. Louis, Missouri; Brun, A. & Co., Oakville, Napa County, California; Craig, W. O., Sonoma, California; Gundlach, J. & Co., San Francisco, California; Matthews, J., Lisbon Winery, Napa, California; Purity Wine Company, San Francisco, California; Russow, Adolph, Proffit post-office, Virginia; Adamson, Rutherford, Napa County, California; Ryckman, G. F., Brocton Wine Company, Brocton, New York; University of California, Experimental Cellar, Berkeley County, California; Aubonin, H., Courtois & Co., St. Helena, California; Krug, Charles.

Honorable mention.—Ben Lomond Wine Company, Santa Cruz County, California; Edge Hill Wine Company, St. Helena, California; Ewer & Atkinson, Rutherford, Napa County, California; Florida Wine Company (orange wine), Clay Springs, Florida; Gast Wine Company, St. Louis, Missouri; Pearson, Alexander M., Vineland, New Jersey; Schram, Jacob, St. Helena, California; Grosmann, H.

Section II.—Spirituous liquors.

Gold medals.—California State Viticultural Commission (brandy), San Francisco, California; Osborn, John, Son & Co. (whisky), New York.

Silver medals.—Hagner, Henry (brandy), Napa County, California; Hume & Co. (whisky and apple brandy), Washington, District of Columbia; Napa Valley Wine Company (brandy).

Bronze medals.—Edge Hill Wine Company (brandy), St. Helena, California; De Turk, J. (brandy), Santa Rosa, California.

Honorable mention.—Nouveau Clos Vougeot Vineyard (brandy), St. Helena, California; Krug, Ch.

Section IV.—Ciders.

Gold medal.—Mott, S. R. & T. C. (ciders), New York City.

CLASS 74.—SPECIMENS OF FARM IMPROVEMENTS AND AGRICULTURAL WORKS.

Silver medal.—Salmon, D. E., Chief of Bureau of Animal Industry, United States Department of Agriculture, Washington, District of Columbia.

Honorable mention.—Salmon, D. E., Chief of Bureau of Animal Industry, United States Department of Agriculture, Washington, District of Columbia (Wickes refrigerator.)

CLASS 75.—VINE CULTIVATION.

Gold medals.—*Clayton, B. F., special agent United States Department of Agriculture, Washington, District of Columbia; * George Husman, Napa, California.

Silver medals.—* T. V. Munson, Denison, Texas; *A. M. Pearson, Vineland, New Jersey.

CLASS 76.—USEFUL AND INJURIOUS INSECTS.

Grand prize.—United States Department of Agriculture, Washington, District of Columbia; Riley, Dr. C. V., Entomologist, United States Department of Agriculture, Washington, District of Columbia.

Gold medal.—Collective exhibit of the United States of nozzles for spraying insecticides. Prepared under the direction of the Secretary of Agriculture, Washington, District of Columbia.

Silver medals.—Dadant, Charles, & Son (Dadant's patents and appliances for bee culture), Hamilton, Illinois; *N. W. McLain, St. Anthony's Park, Minnesota; *Philip Walker, Washington, District of Columbia.

Bronze medals.—Newcomb (apicultural appliances), Illinois; *A. J. Cook, Lansing, Michigan; *G. W. Demaree, Christainsburg, Kentucky; *W. T. Falconer, Jamestown, New York; *G. L. Tinker. New Philadelphia, Ohio; *A. C. Tyrrel; *James Heddon, Dowagiac, Michigan; *C. F. Muth & Son, Cincinnati, Ohio; *Newman & Son, Chicago, Illinois; *A. I. Root, Medina, Ohio; *Jas. H. Van Deusen & Sons, Sprout Brook, New York.

CLASS 73*bis* (2D DIVISION).—AGRONOMY; AGRICULTURAL STATISTICS.

Grand prize.—United States Department of Agriculture, Washington, District of Columbia (collective exhibit of agricultural scientific work).

Gold medals.—Dodge, J. R., statistician, United States Department of Agriculture, Washington, District of Columbia; Fernow, B. E., chief of Forestry Division, United States Department of Agriculture; Saunders, William, Horticulturist; United States Department of Agriculture, Washington, District of Columbia; Commissioner of Agriculture of the State of Kansas.

Silver medals.—Salmon, Dr. E., Chief of Bureau of Animal Industry, United States Department of Agriculture, Washington, District of Columbia; Galloway, B. T., Division of Vegetable Pathology, United States Department of Agriculture, Washington, District of Columbia; Merriam, Dr. C. H., chief of Ornithological Division, United States Department of Agriculture, Washington, District of Columbia.

CLASS 73 (3D DIVISION).—ORGANIZATION, METHODS, AND APPLIANCES OF AGRICULTURAL INSTRUCTION.

Silver medals.—Atwater, Prof. W. O., chief of Office of Experiment Stations, United States Department of Agriculture, Washington, District of Columbia: Taylor, Dr. T., microscopist, United States Department of Agriculture, Washington, District of Columbia.

CLASS 82.—SEEDS OF FOREST TREES.

Bronze medal—*B. Fernow, Washington, District of Columbia.

CLASS 49.—APPARATUS AND METHODS OF FARMING AND FORESTRY.

Grand prizes.—McCormick Harvesting Company, Chicago, Illinois, mowers and reapers; Walter A. Wood, Hoosick Falls, New York, mowers and reapers.

Gold medals.—Batcheller & Sons, Wallingford, Vermont, hay forks; Johnston Harvester Company, Batavia, New York, harvesters; Whitman Agricultural Company, St. Louis, Missouri; wool, hay, and straw press.

Silver medals.—Armour & Company, Chicago, Illinois, manures; Chadborn & Coldwell Manufacturing Company, Newburg, New York, lawn mowers; W. & B. Douglas, Middletown, Connecticut, pumps and hydraulic rams for garden and farm; Samuel Johnston & Company, Brockport, New York; Lloyd & Supplee Hardware Company, 503 Market street, Philadelphia, Pennsylvania, lawn mowers; D. M. Osborn & Company, Auburn, New York, reapers and mowers.

Bronze medals.—Bradley & Company, Syracuse, New York, reapers and mowers.

Honorable mention.—Plano Manufacturing Company, 81 and 83 Monroe street, Chicago, Illinois, reapers and binders.

APPENDIX VI.

REVIEWS OF THE UNITED STATES AGRICULTURAL EXHIBIT FROM LEADING FRENCH AND ENGLISH SOURCES.

[AGRICULTURAL SCIENCE IN THE UNITED STATES.—THE BUDGET, BUREAU OF ANIMAL INDUSTRY.]

[Translated from Leon Grandeau in *Le Temps*, August, 17, 1889.]

Agriculture in all countries has been the last to receive in the councils of the state that attention which, out of regard for the national prosperity, its predominance over all other national industries should have secured for it—an indifference difficult of explanation. France has had a special minister of agriculture only during the past eight years. The United Kingdom has only just endowed, by a recent act of Parliament, an institution analogous to that created by Gambetta, which, indeed, served them in great part for a model; and it was only on the 11th of last February that President Cleveland approved the act by which Congress established a special department under the title of the Department of Agriculture of the United States.

Congress took the first step in this direction in 1862. The law of May 15, approved by President Lincoln, established the foundations of an independent department of agriculture, but the functionary then placed at the head had only the title of Commissioner of Agriculture and was not a member of the Cabinet. The services rendered by the new department, under the charge successively of the several Commissioners, from Isaac Newton to N. J. Colman (from 1863 to 1889), have each year increased. It has gained year by year more and more of the confidence and favor of the farmers, the scientific agriculturists, and the general public; so much so that it has at last received, "in being elevated into an independent department, the official rank due to a bureau which has under its administration the interests of a large portion of the inhabitants and the principal source of national prosperity."

On February 11, 1889, President Cleveland nominated as Secretary of Agriculture Hon. Norman J. Colman, the then Commissioner of Agriculture. On the change of administration, 4th of March, 1889, Secretary Colman resigned his office, and Hon. J. M. Rusk, of Wisconsin, was nominated Secretary of Agriculture by President Harrison. Hon. E. Willits, president of the Agricultural College of Michigan and director of the experimental station of that institution, was made Assistant Secretary.

The general organization of this Department, the appropriations which it has at its disposal, its relation to the farmers, and the direction given to its different labors, make it seem worthy of study as to its general features. The system of land tenure and the condition of agriculture in the United States, so different in all respects from that of the old countries with their dense populations, necessarily calls for a special organization in the Department of the Minister of Agriculture. I have already spoken of the remarkable development by the Government at Washington of statistical information of all kinds designed to guide and instruct the farmer, so to speak, from day to day with regard to all facts that would promote his interests. It seems to me useful to complete this survey of the organization of the Department of Agriculture by making use of the data exhibited in the Quai d'Orsay, and the oral explanations so courteously given me by Messrs. Riley and Dodge, the commissioner in charge of the American section and one of his efficient colleagues.

There are in the United States actually engaged in farming about 4,000,000. The mean general proportion out of each 100 of those classified as actual proprietors, working on shares, and renting farms, is as follows:

Those working their own farms	74.50
On shares	17.50
Renting	8.00
	100.00

That portion of the population employed in agriculture, which, as we have said,

is 44 per cent of the total population, is apportioned very unequally among the forty-six States and Territories, as will be seen by the following table:

	Per cent.
In 6 States from	72 to 83
In 9 States from	57 to 69
In 15 States from	52 to 35
In 10 States from	34 to 18
In 6 States from	15 to 9
46 States and Territories	44

Three-quarters of the improved land in America being cultivated by the owners, representing 92 per cent of those engaged in agriculture, it may be readily understood that the General Government has for many years endeavored to form closer relations with the mass of the farmers scattered over that great country. Therefore, as the official report says, "The task of the Department of Agriculture is not confined to the daily routine of a bureau. Lectures, articles, memoirs prepared by the chief officers and members of the scientific staff of the Department, and which are read before agricultural associations, scientific societies, and the general public, are daily becoming of greater importance. The Department is continually putting forth greater efforts in making discoveries and in classifying facts and principles in the science of agriculture exhaustively, in order that these facts and principles may be clearly understood and intelligently and successfully applied in practice on thousands of farms thoughout the country."

In its actual organization the Department of Agriculture comprises the Secretary and his clerks, the Assistant Secretary, the chief clerk—who also attends to keeping in order the buildings of the Department—the Division of Accounts, the library, the Bureau of Animal Industry, those of Statistics, Entomology, Chemistry, Botany, Pomology, Ornithology, Microscopy, Forestry, the Seed Division, and that of Gardens and Parks. Before discussing the duties of these different bureaus it may be well to note the apportionment of the appropriations.

For the fiscal year ending June 30, 1890, the following sums were granted by Congress to the Department of Agriculture:

Bureaus of the Secretary	$83,060
Division of Botany	45,500
Division of Pomology	7,500
Division of Microscopy	4,700
Division of Chemistry	24,900
Division of Entomology	37,300
Division of Ornithology and Mammalogy	15,060
Division of Experimental Garden and Grounds	29,140
Museum	4,120
Seed Division	108,450
Statistical Division	109,500
Forestry Division	10,000
Bureau of Animal Industry	415,000
Printing	4,200
Books, etc., for library	2,000
Furniture and repairs	7,350
Postage	4,000
Miscellaneous expenses	15,000
Experiments in manufacture of sugar from sorghum, etc	25,000
Experiments in silk-culture (Division of Entomology)	20,000
Experiment Stations	585,000
Bureau of Experiment Stations	15,000
Total	1,572,780

The best commentary upon this appropriation will be a rapid description of the various duties for the accomplishment of which provision is thus made in a manner to excite the envy of the agriculturists of the Old World. Let us pass them rapidly in review.

SECRETARY OF AGRICULTURE.

The functions of the Secretary of Agriculture are, in a general way, those which appertain to all the members of the President's Cabinet. As a member of the Cabinet the Secretary of Agriculture is an adviser of the President, not only upon questions relating to agriculture, but also upon the general management of the Government. As chief executive of the Department, he has the appointment of

subordinate officers, and conducts the business of his Department, with Congress, other branches of the Government, and the public. He has general supervision of the Department; he attends to the carrying out of the provisions of acts of Congress concerning agriculture; he sets on foot various measures in the interest of agriculture to aid farmers in the theory and practice of their art. The workings of the Department are largely under the immediate supervision of the Secretary, and the large appropriations made by Congress, both for general and special purposes, are expended under his direction and at his discretion. Like all the heads of Departments in the United States, he is responsible to the President and is obliged to render him an account of the interests intrusted to him. In enlarging the powers and privileges of the Department an Assistant Secretary was appointed, under whom were placed the eight technical divisions of the Department. The Assistant Secretary has a general supervision of these and directs their studies and operations. All correspondence relating to scientific matters is submitted to him for approval and signature.

The chief clerk has charge of the buildings of the Department. He is at the head of all the employés, passes upon all requests for leave, and in a general way directs the working force of the Department.

The title of chief clerk of the Division of Accounts and Expenses is sufficiently explanatory of itself. He also has charge of the archives.

The library, which contains 18,000 volumes, is in charge of a lady, Mrs. E. H. Stevens.

That branch of the service relating to papers and records has a special importance to the Secretary, owing to the extensive publicity given to the official publications concerning agriculture. In 1888 there were packed, labeled, and sent off from this Bureau not less than 749,500 documents, namely, 400,000 copies of the Annual Report of the Department, and 199,000 copies of the Report of the Division of Statistics. The balance, perhaps 150,000 copies, were reports of the labors of the different divisions.

Bureau of Animal Industry—This division was established by act of Congress of May 28, 1884. The following are the various duties devolving upon it:

(1) Investigations and reports upon the condition, protection, and uses of the domestic animals of the United States.

(2) Investigations and reports as to the causes of contagious and infectious diseases among domestic animals, and their remedies, both curative and preventive.

(3) Collection and preservation of all information on the preceding subjects which may prove useful to the agricultural and commercial interests of the country.

(4) Examination and reports upon the best methods employed both in the United States and foreign countries in treating, transporting, and caring for animals; the means employed to suppress pleuro-pneumonia and prevent its spread.

(5) Investigating and suppressing pleuro-pneumonia by inspecting, putting in quarantine, and slaughtering infected animals, and disinfecting buildings and cars.

(6) Original scientific research undertaken at the experimental station and in the laboratories at Washington in the preceding subjects.

(7) Directing and managing quarantine stations for imported animals.

(8) The classification of the reports of inspectors of animals, with indices and résumés; correspondence relative to diseases of animals, and the preparation of reports for publication.

At the end of the year the chief of the Bureau, conjointly with the Secretary, selects certain subjects mentioned in paragraphs 1 to 3, which shall be subjects of special research. He designates men of well-known competence to whom these researches shall be intrusted. These specialists reside in different parts of the United States; they are expected to change their residence if necessary in order better to perform their duties.

The service relative to pleuro-pneumonia, the ravages of which are well known, is organized as follows: The Secretary, upon the recommendation of the chief of the Bureau, appoints inspectors whose duty it is to inquire into the existence of pleuro-pneumonia in localities supposed to be infected. These reports, made weekly or even more frequently, keep the Secretary informed of all interesting facts in this regard.

Immediately upon the discovery of pleuro-pneumonia information is sent to the chief of the Bureau and the chief inspector of the State in which the discovery is made, and the herd is put in quarantine. The inspector-in-chief at once visits the herd to verify the diagnosis of the inspector, and sends a report of his conclusions to the Bureau. As the external diagnosis of the disease is made with difficulty, and is rarely conclusive, the chief of the Bureau is frequently obliged to verify it personally. When the existence of the disease is made certain, the herd is quarantined permanently. The affected animals are purchased at half price and slaughtered with the authority of the State where the disease exists; the buildings are thoroughly disinfected, and the quarantine is raised. The inspector is also required to

search out the origin of the disease and the animal or animals which brought it to the stables.

When pleuro-pneumonia is detected in more than one herd in the same locality, a quarantine is established for the whole district, the limits being fixed by the chief of the Bureau. The strictest precautions are adopted to prevent the violation of the quarantine and the spread of the disease while the attempt is making to suppress the disease in the quarantined district.

Quarantining animals arriving from foreign countries is among the duties of the Bureau. There are five quarantine stations, situated at Littleton, Mass.; Garfield, N. J.; Philadelphia, Pa.; Patapsco, Md., and San Francisco, Cal. Importers are obliged to take out a permit stating the number of head imported and the ports of embarkation and arrival; this permit gives admission to these quarantine stations. On the arrival of vessels loaded with cattle, the custom house officials send notice to the directors of the quarantine station at the port, who visit the vessel, examine and take charge of the imported cattle, and put them in quarantine for ninety days. At the end of that period, if the cattle prove to be free from all diseases, the quarantine is raised and the importers are authorized to remove them to any desired point.

This is the line of action of the Bureau of Animal Industry, for which the appropriation of $500,000 is justified by the numerous labors of which it has the direction and for which it is responsible.

[AGRICULTURAL EXHIBIT OF THE UNITED STATES AT THE QUAI D'ORSAY.—COMPARISON OF THE PRODUCTION OF CEREALS.—THE DIVISION OF SEEDS IN THE AGRICULTURAL DEPARTMENT OF THE UNITED STATES.]

[Translated from Leon Grandeau in *Le Temps*, August 20, 1889.]

What is the total production of cereals in the entire world? What is the proportion, per capita, of the home product in the various countries? If it is difficult to give an exact answer to these two questions, it is still possible, thanks to the Bureau of Statistics in the Agricultural Department, to furnish statements which closely approximate the truth. In the United States the mean annual production of cereals has been in the last two decades as follows:

	Hectoliters.
From 1870 to 1880	680,833,000
From 1880 to 1887	982,554,000

The total for the year 1888 is 1,163,200,000 hectoliters. Under the name "cereal" should be included wheat, rye, oats, barley, corn, and buckwheat. These grains are produced in the United States in very different amounts. Corn alone represents five-eighths of the amount harvested. Wheat and oats form, as we have seen, the greater part of the remainder; the united product of rye, barley, and buckwheat do not amount to more than 3 per cent of the entire yield.

Taking the actual population of the United States of America, the total production of cereals per capita in 1888 was 18.54 hectoliters, exceeding by about 2 hectoliters the product of the last decade. The best authenticated statistics place the mean annual production of cereals of the globe in round numbers at 2,500,000,000 hectoliters (rice and millet not included). This amount is apportioned as follows between the importing and exporting nations; that is to say, between the countries in which, one year with another, the home supply is not equal to the demand, and those countries which, on the other hand, may annually come to the aid of less favored regions. The following figures are given for Europe:

Countries importing.	Production (in millions of hectoliters).	Importations (in millions of hectoliters).
United Kingdom	121	68.1
German Empire	262.6	23.3
France	233.9	14.6
Austria-Hungary	166.9	4.1
Italy	97	3.1
Spain	90	....
Portugal	13.4	6
Greece	4.4	.2
Switzerland	6.5	3
Belgium	23.5	3.1
Netherlands	10.	2.6
	1,029.2	128.1

Countries exporting.	Production (in millions of hectoliters).	Exportation (in millions of hectoliters).
Russia	587.5	45
Roumania	39.3	8
Turkey	30.7	1.5
Norway and Sweden	25.5	3.3
Denmark	....	4
	683.	61.8

It follows from this table that old Europe, producing annually on an average 1,700,000,000 hectoliters of cereals, has not sufficient for the consumption of its population and the support of its cattle. The difference between the necessary importation and the exportation of some European countries into other parts of the continent leaves a deficit of more than 66,000,000 hectoliters which the New World is called upon to supply. The total production of the New World may be estimated as follows in millions of hectoliters:

United States	581.4
Canada	35.6
Egypt	22.5
Algeria	53.7
Australia	13
India	60
	766.2

Of this a tenth scarcely suffices to supply the deficit of Europe.

To give these general statements their full economic significance it is necessary to ascertain what the home production puts into the possession of each inhabitant of the different European countries; the comparisons which the data presented to us in the exhibit of the United States permit, are very instructive.

Taken as a whole, the European yield of wheat, rye, corn, oats, barley, and buckwheat represents, it may be, 574 liters per year per capita. The product of the United States of America is very nearly triple this; it is, in fact, 1,610 liters per capita. As might be thought, upon consideration of the figures given above the proportion of the amount of cereals per capita varies much in the different European countries. It has seemed to me useful to give the more exact figures of the following table:

	Hectoliters.		Hectoliters.
Europe	5.74	Ireland	4.15
United States	16.10	Belgium	4.72
Switzerland	2.22	Spain	4.94
Greece	2.29	Austria	5.13
Servia	2.80	Germany	6.22
Portugal	2.87	France	7.16
Great Britain	2.94	Roumania	7.23
Italy	3.02	Russia	7.38
Norway	3.38	Hungary	7.49
Netherlands	3.42	Sweden	8.25
Turkey	4.33	Denmark	16.21

Denmark is the only country of the Old World whose production per capita equals that of the United States. France, with a mean yield of 7 hectoliters, produces nearly enough for home consumption. The four nations which follow France are exporters; all the others are dependent upon foreign countries for cereals.

I have already said that it is not the productiveness of the soil which in the United States permits exportation, but the extent of territory proportioned to its population which is devoted to the raising of cereals. It might be supposed after this that the Americans will be eager to extend their tillage over new territories in proportion to the foreign demand, and that their system of cultivation dooms them necessarily to a small yield. This is an error that it is well to combat in noting the efforts of the Department of Agriculture at Washington towards an improvement of the yield.

Those who have done me the honor of following the warfare which I have waged for some years past in this Revue are convinced, I hope, that the foundation of all

efforts for an increase of the yield is in the application of the facts of physiology to the culture of plants. The increase of soil production, as my readers know, depends preëminently upon a knowledge of the requirements of plant nutrition, and the introduction into the soil of nutritive substances in form and quantity adapted to the plant's use. Appropriate and abundant fertilizing material is not the only thing that affects the yield. The nature and quality of the seed plays almost as important a part, and the immediate purpose which the tiller of the soil, solicitous for his own welfare, should keep in mind is to unite with suitable fertilizers a good selection of seed. But where shall the farmer ascertain what fertilizers to use, what seeds to sow? He does not know how to determine; he must depend upon the experiments made by the scientific agriculturists, who are prepared by their studies to solve these problems. It is to these he must look for guidance. One of the most interesting parts of the exhibit of the United States is that which sets forth the efforts of the Department of Agriculture to popularize science in that vast country, which we are too apt to consider, through our ignorance of what is passing there, as entirely absorbed in increasing the extent of their arable land without regard to the practical application of scientific methods.

The course upon which the United States entered some years since in that respect well merits attention. Is it not inevitable, indeed, that a country which, simply by the natural fruitfulness of its soil, produces about 12 hectoliters of wheat and 24 of corn per hectare, will easily double its yield when, feeling the need of so doing, it adds scientific methods to such extensive areas? It is this with which the old countries will have to contend, with disastrous results, I fear, if they do not take steps to make their home production equal to the home consumption.

It is undeniable that the increase of the yield per acre will have in the United States the same effect as with us, namely, the lowering of the price of wheat and corn, enabling the growers of the New World to offer us at a still lower price the cereals which we should have raised ourselves, and which we shall be obliged to seek from them.

What is the Government at Washington doing to accomplish this improvement in agricultural methods, and to reinforce by the aid of science the natural fertility of the soil? It is of interest to us, I think, to know exactly what is doing in that respect. I have already set forth the recent organization of the Department of Agriculture, and begun to explain the general plan. I stopped at the Bureau of Animal Industry which directs the zoötechnic work, and showed the attention given by the Government to domestic animals. Other labors are directed with no less care to the study of plants in the interest of agriculture. General botany, vegetable pathology, horticulture, have their distinct bureaus in the Department of Agriculture. Moreover, the subject of seeds has been judged worthy of a special branch of the service. The Government has thought it a matter of great importance that it should come to the aid of agriculture by distributing seeds of a variety appropriate to the different districts, the qualities, both as regards character, germination, and yield, having been previously tested. There are still greater reasons why this service should be organized in countries where the question of the yield assumes an importance much greater than in the United States. There, immense territories still await the tiller of the soil, while with us there is need rather of restricting the amount of land under cultivation and improving the yield of that portion devoted to the raising of cereals. It behooves us, then, to become acquainted with the details of the organization of the seed division of the Department of Agriculture at Washington.

The first appropriation for the distribution of seeds was very modest, viewed in the light of later experience. It was estimated in March, 1839, that $1,000 would suffice not only for the distribution of the seeds but for carrying on the researches of the Department. The mean sum annually expended during the succeeding fourteen years did not exceed $2,800. In 1854 the appropriation for this object was $3,500. The amount has been gradually increased, and for some years has been about $100,000 a year for the distribution of seeds, plants, and roots. The average weight of seeds sent out from the Department through the post-office during the last five years up to June, 1888, has been 200 tons.

The division purchases seeds from reputable merchants and growers, both in the United States and foreign countries, carefully keeping a record of their names. It thoroughly tests the seeds with regard to germination, purity, and freedom from seeds of noxious weeds, and eggs or larvæ of injurious insects, before paying for them. They are then stored, each bearing a card giving its name, product, and, when necessary, instructions as to planting and culture. The division distributes these seeds among the members of Congress, upon demand, for the use of their constituents. This disposes of about two-thirds of the total quantity. The surplus is sent to the 4,200 agents of the Department in the States and Territories, and to

foreigners who desire to exchange with the United States. A daily register is kept of all received and sent out. At the end of the fiscal year a detailed report is published, in which are condensed, classified, and preserved for future use the reports sent in by those to whom seeds have been sent.

It is an established principle in the Department to distribute the greatest possible variety of seeds over as wide a territory as possible, in order quickly to determine with regard to each new variety its power of adaptability to a new environment, or its fitness for a given locality.

It is needless, I think, to enlarge upon the benefits to agriculture that must result from such an organization.

[Scientific Agricultural Institutions of the New World, United States of America, Argentine Republic, Chili, Australia, etc.]

[Translated from Leon Grandeau, in *Le Temps*, August. 24, 1890.]

In new countries, where spontaneous vegetation has for centuries accumulated in the soil those materials which are indispensable to the nourishment of plants, a mere scratching of the surface has generally sufficed to put the earth in condition to furnish crops during a certain period more or less long. From a consideration of the documents furnished on this subject by the foreign exhibit, it would seem that these virgin soils, without manuring, can be depended on for a yield of 10 or 12 hectoliters per hectare. (This is a minimum figure.) Small as is this yield, however, the absence of those heavy expenses imposed upon the cultivation of the soil in the more populous regions of Europe suffices to render it fairly remunerative. This natural fecundity, however, is necessarily limited. A system which consists in calling upon the soil to produce, without any restitution whatsoever, wheat, corn, potatoes, etc., a system which Liebig justly characterizes as "vampire cultivation," can exist but for a time. Already certain regions of the New World are beginning to experience the exhaustion, inevitably resulting from a total absence of restitution, and enlightened minds foresee a near future when manure will have to supplant the natural resources of the soil. On the other hand, the scientific movement which has impressed upon the agriculture of the old continent the seal of progress, of which an impression is to be found at every step in the galleries of the Universal Exposition, is not, as some people may suppose, the exclusive property of Europe. The exposition of the States of both Americas and Australia are there to attest the importance attached by the governments of the New World to the adoption of scientific knowledge among agriculturists and to the high esteem in which they hold practical experimentation as applied to agriculture. What the United States of America, the Republics of Chile and Mexico, the Argentine Republic, Australia, and Canada have accomplished in this direction during the past ten years is truly a revelation for the greater number of European agronomists. It would be impossible to ignore the economic importance of this scientific movement among nations where the cultivated portions of the land represents actually but a very insignificant proportion of the tillable lands. From extensive, as it now is, the agriculture of the New World is preparing to become intensive. It might have been believed that, for a long time yet, these regions, so sparsely peopled, possessed of an immense extent of territory, would have been satisfied to leave to the natural conditions of soil and climate the increase of their agricultural productions. The creation of experimental stations for investigation, of schools of agriculture both theoretical and practical, indicates quite the intentions and concern on the part of rulers of these countries who, profiting already by the example of the nations of the Old World, are appealing to science to aid in the development of agriculture. If I am not mistaken there is in this movement matter to command the greatest consideration from our European producers. A transformation, at short notice perhaps, of the method in the treatment of the soil and the improvement of the breeds of cattle on the other side of the ocean, seems to me a subject to excite the earnest attention of European agriculturists and to incite them to an earnest advance on the road of progress.

I recently called attention to the general organization of the Department of Agriculture of the United States, notably to its excellent method of the propagation of new seeds of the highest quality, but the opportunity of the Government at Washington in the development of scientific institutions with which it has endowed the entire country, does not stop at this important service. Ten schools of pomology have been instituted with the view of giving to American youth well-grounded agricultural instruction; forty-seven agricultural experiment stations have been created, on the model of European stations, during the past fifteen years, and distributed in the various States. The schools of agriculture generally occupy four years of study,

and in addition to the fundamental science in their application to agriculture they teach literature, Latin, French, German, history, and drawing. They are indeed actual establishments of secondary instruction in which a large place is given to agricultural science and often to practical agriculture. [Then follow some facts and figures relative to the establishment of the experiment stations with which most American readers, interested in this subject, are already familiar and a consideration of the South American Republics.]

[The Agricultural Exhibit of the United States.]

[From the *London Morning Post*, May 29, 1889.]

There is probably no section of the Paris Exhibition which possesses greater interest to British farmers than that devoted to the agriculture of the United States. So large a portion of our food supply, particularly of flour and beef, is derived from the States, that it becomes instructive to inquire what account the American agriculturists render of themselves in the great industrial exhibition which is now in progress. It may at once be said that the grouping together of the many and varied objects of interest and study in the American Agricultural Department is a work that must have involved much patient care and discrimination on the part of the collectors. The task of the Assistant Commissioner in charge, Prof. C. V. Riley, entomologist to the United States Department of Agriculture at Washington, has been one of no ordinary difficulty. To prepare a faithful representation of the American agricultural industry, and in the very limited space available to display it, in a manner which would worthily reflect the extent of area, variety of climate, diversity of interest, and the industrial energy of 70,000,000 people, is a problem that seldom demands solution. On entering the United States court at the east end of the Quai d'Orsai, between the Pont d'Alma and the Pont des Invalides, the visitor sees a display of forest products from the great lumber regions of the States. These are exhibited in various stages from the raw timber to the manufactured product. Associated with this display is a model of a tree-planting machine of great merit, the machine itself having been proved capable of planting as many as 8,000 or 10,000 trees in a single day. Close at hand is seen a valuable series of wall charts illustrating in graphic form the economic features of cereal cultivation, agricultural education, railroad development, and subjects of allied character. A collection of cotton-fiber products includes a large number of specimens of raw cotton, cotton seed, cotton-seed cake and oil, and cotton-oil soap. Adjacent to this exhibit is a variety of specimens of flax, jute, and of the ramie fiber grown in Texas. Next is a collection of the wools produced in different parts of the Union by the various breeds of sheep at present in favour with American farmers. The native fruit industry is illustrated by an exhibit comprising raisins, oranges, and nuts, models of apples, pears, and other cultivated fruits, and a series of American wines. At the other end of this court the surroundings are chiefly corn and honey.

The grain exhibit is almost bewildering in the number and variety of products. In one case alone there are upwards of 250 varieties of seed grains—"corn" or maize in every conceivable form, from all the principal grain-growing regions of the Union. A series of samples from the Chicago Board of Trade, prepared and sealed by their inspector, may also be noticed. An instructive collection of prepared food stuffs, or, to use the American term, "breakfast cereals," includes pearl hominy, yellow Indian meal, crushed wheat, rice, and rice meal. A remarkably fine exhibit of hops, which grow to perfection in Oregon, is appropriately flanked by a series of bottles of American beer. The honey collection includes honey in every known form, a series of bee appliances, and the packages in general use for shipping and marketing the produce of the hive. In inspecting these, the visitor can not fail to remember that, in the States, bee-culture is followed for profit, and not merely for pleasure. The very beautiful display illustrative of the economic entomology of the United States, specially prepared by Dr. Riley himself, will well reward the most minute inspection, for it includes specimens not only of useful insects, but of the many insect pests, including Hessian fly, Army Worm, Rocky Mountain locusts, and numerous others which annually inflict enormous loss upon American farmers. The specimens are shown in conjunction with specimens of the plants which they attack, in order to indicate the nature of the injury and to suggest remedial or preventive measures. The ruinous losses which insect pests occasion in the States are so great that it is hardly matter of surprise that the members of the American Agricultural Commission proceeded to inspect and ex-

amine the Strawsonizer directly this English invention was put on view, and that they are awaiting with much interest the public trial of this destroyer of insects, which is shortly to take place in Paris.

The exhibit of vegetable products includes preserved maize of the sweet variety grown for table use, tomatoes, pease, and other vegetables, bottled or canned in the manner familiar to housekeepers. Forage plants, and grasses are presented in a collection of great variety and interest, and whilst the grasses include a few forms known in British agriculture, most of them are of a characteristic American type. The silk industry is not overlooked, but this section is of more direct interest to French than to English visitors. Illustrations are afforded of the various stages of manipulation through which the raw material passes, and there are shown 64 specimens of cocoons produced in the United States, including several specimens of a cross-bred race, raised with no outcrossing for eighteen years. A carefully made selection of tobacco products from Virginia, Kentucky, Connecticut, and Maryland serves to show to what perfection the American tobacco industry has attained. A small group of sugar maples and sorghum plants will remind the Continental cultivators of sugar beet that their industry is one that has not escaped the competitive instincts of American enterprise. The sorghum industry of the States was never more promising than now, and though the trade in sorghum products is not yet large. the future is hopeful. The whole collection of vegetable fibres in the American section is in charge of Mr. Charles R. Dodge, of Washington, son of the well-known agricultural statistician. The exhibit of animal products is similarly the special work of Mr. James Cheesman, of the New England Creameries Association, Boston, Massachusetts. As an accomplished dairy expert, Mr. Cheesman's name is well known in England, and the United States Department of Agriculture has done well in placing the animal products section under his control. A large collection of cut meats, lard, hams, and canned products from Chicago packers and other well-known houses, in the eastern States, bears eloquent testimony to the efforts that are being made to secure for the States a world-wide trade in the animal produce of the prairie and the cornfield. A large number of very graphic charts and maps indicate the growth and development of this industry from 1810 to 1884, and give the numbers of animals and their values in periods of five and ten years. The dairy display is included in the animal products exhibit, but is not yet complete. The cheese and butter exhibits will be contained in a refrigerator constructed for the purpose. Amongst the varieties of cheese may be specially noted, besides the ordinary dairy cheese as made in England and the American cheddar or factory cheese, the Young America, the pineapple, and the sage cheese, all of which are peculiar to the country. The butter has been selected with a view to the development of European trade, but it will include a number of small packages, such as are used for the home trade in the States. It was thought desirable to transport in small packages for the purpose of testing the quality by a more severe trial than is ordinarily given to butter in large packages. In connection with the dairy exhibit is an ingenious working model of a creamery operated on the cream-gathering system, as usually practiced by American factory butter-makers.

Live stock, of course, are not included here, but it is impossible to pass over Mr. Cheesman's series of photographs of rare breeding, taken by Messrs. Schrieber & Sons, of Philadelphia. They represent animals which received the highest awards at the National Dairy Fairs of 1887 at New York, and of 1888 at Buffalo, and comprise some of the choicest dairy blood known to breeders, including Guernseys, Jerseys, Ayrshires, and Holsteins. Among these may be mentioned the imported cow Select (2,205), calved April, 1878; she was tested for seven days on the island of Guernsey, and made 22¼ pounds of well-worked unsalted butter, on a daily ration of 3 quarts of crushed oats and 3 quarts of wheat bran. with grass; she is now the property of Mr. Francis Shaw, New Braintree, Massachusetts. The Ayrshire cow Duchess of Smithfield (4,256), dropped December 20, 1876, gave, in an official milk test under the supervision of the Ayrshire Breeders' Association, 464 pounds of milk in seven days; her butter record for seven days is 19 pounds 6 ounces, and she has given 10,748 pounds of milk in one year. She is now the property of Mr. H. R. C. Watson, West Farms, New York. It will not be out of place to mention also the choice series of large photographic views of the scenery and natural features of the Yellowstone Park. Having inspected the products of the great expanse of prairie. the visitor can rest his eyes upon the inimitable beauties of the great national park in southwest Montana. The Yellowstone is a magnificent example of "the long result of time," and though our American friends can boast of an extraordinarily varied and instructive display of their agricultural resources, they have acted wisely in lending a charm to their exhibits by these admirable views of one of the wonders of the world. The United States agricultural implement department forms a separate section.

[THE AGRICULTURAL EXHIBIT OF THE UNITED STATES.]

[From the *London Morning Post*, Aug. 6, 1889.]

The opportunity afforded by the Paris Exhibition of displaying in Europe the remarkable agricultural resources of the United States has been utilized to the full by the Government of that country. For no European country does the agricultural development of the American Republic possess greater significance than for Great Britain, and now that the United States agricultural exhibit at Paris is complete attention may profitably be directed to its salient features. The whole display is based on a scientific plan, and is intended, by means of illustrations, charts, models, and specimens of produce, to instruct as to the methods and processes of cultivating, harvesting, and preparing each particular product for the market. The scheme adopted is to arrange the exhibits in four principal divisions, devoted respectively to (1) animal products, (2) food substances of vegetable origin, (3) commercial vegetable products, not foods, and (4) agricultural education. The Commissioner of Agriculture at Washington placed the arrangements in the experienced hands of Professor C. V. Riley, who has certainly achieved excellent results when the immense area brought under representation is taken into consideration. Assisting Professor Riley in Paris are Prof. James Cheesman and Mr. Charles R. Dodge, and it is only due to these two gentlemen to say that they are both imbued with the same spirit of enthusiasm and perseverance as characterizes their chief, whilst all alike are models of courtesy and kindness to everyone who seeks further information as to the American exhibit. The animal products division is subdivided into two sections, one for meat and dairy products, and the other for economic entomology. The display of animal products is probably the most important part of the exhibit, and has been prepared with the assistance of Dr. D. E. Salmon, chief of the Veterinary Bureau at Washington. It is difficult to arrive at a true conception of the importance of the meat and dairy interests in the United States. Every year is marked by an enormous increase in the number of animals slaughtered for food, and equally an increase in the number of tons of meats of all kinds exported. In illustration it may be stated that in 1880 there were owned in the State of Texas 4,000,000 head of cattle, and that at the close of 1888 this number had increased to 6,336,000. Texas is cited as being the largest cattle-producing State in the Union, though it is but one out of 42 States. To compare with the number just given it is worthy of note that, according to the agricultural returns for 1888, the total number of cattle in the whole of Great Britain was 6,129,375, which is slightly exceeded by the number in Texas alone. The meat industry is represented at Paris by several firms, who show packed and cured meats of various kinds which have all been successfully conveyed across the ocean—some having even traveled a distance of over 5,000 miles —by means of refrigerator cars upon American railways, and by cold storage upon transatlantic steamers. It appears that France has not yet withdrawn her prohibitory statute against the introduction of American pork products into her territory. However, a movement is on foot to obtain the repeal of this decree, and in the meantime pork products are admitted to the Exhibition by special arrangement.

The American meats are kept in a large and admirably constructed refrigerator, made expressly for the United States Government by the well-known Chicago firm, Messrs. Wickes & Co. This refrigerator, which has no parallel in the Exhibition, has been much admired by visitors, and it is a pity that it is not illuminated from within, a defect which arises from some difficulties between the Exhibition authorities and the electric-light companies, which the United States Commission has been unable to overcome. In this same refrigerator may be seen the American dairy exhibits of butter and cheese. These are necessarily small, but they form a most representative collection, and it is, indeed, doubtful whether so fine a collection of butters has ever been brought together before. Amongst them are the products of three of the best known American dairy farms, all in New England. These farm-made butters command a high price in the United States throughout the year. Besides these exceptional butters there is a collection of butters made on the factory system, all of good quality, and well kept after crossing the ocean. The American cheeses are less striking in quality than the butters, yet they are well made, rich in flavor, and well cured. Even more instructive, perhaps, than the exhibits themselves are the photographs, maps, and charts, illustrating the types of animals and the methods of husbandry, and of slaughtering of animals which are so characteristic in their extent and economy of labour. Large price charts show the wonderful increase since 1825 of the product in mess pork, mess beef, mess hams, butter, cheese, and lard; others show the number of cattle, hogs, horses, and sheep for each decade since 1840, and for 1888. In addition are maps showing the distribution of cattle and hogs throughout the States, the whole telling most eloquently of that marvelous material growth which is the wonder of the century. The value

of the meat product of the United States is now £150,000,000 sterling, of which £13,000,000 worth is annually exported. The value of the butter product is £39,000,000, of which about £300,000 worth is exported. In the section of applied entomology, as might have been expected, since it is Professor Riley's specialty, the exhibit as a whole far excels anything else of the kind in the Exposition. There is a large and varied display of appliances for bee-culture, and for the preparation and marketing of honey. In no other country of the world are so many persons engaged in honey producing, and nowhere else is so much honey produced at so low a cost. The many forms of hives, of honey extractors, foundation comb presses, and other contrivances for facilitating the management of bees and the marketing of their products, all show that our American cousins are foremost in the application of inventive genius to this branch of rural industry. No less than eighteen different patented forms of beehives are shown, besides a comprehensive series of different honeys in the comb and in various sealed packages. One large case is devoted to these honeys, those from lime blossom, white clover, sage, and mangrove being particularly noticeable for their excellent quality. Wax extractors, bee smokers, various forms of honey confectionery, and even honey wine and honey vinegar, are all to be seen here. It is estimated that in the United States there is a total of 3,000,000 colonies of bees, annually yielding 120,000,000 pounds of honey. The value of this annual product, at an average price of 15 cents per pound, would be £3,600,000 sterling. The estimated annual product ranges from £3,000,000 to £4,000,000 in value, and the annual production of wax is calculated to be worth £200,000.

In the silk exhibit, prepared with the assistance of Mr. Philip Walker, silk agent of the Department of Agriculture, there are sixty-four specimens of different kinds of cocoons raised in the United States, not the least interesting of which is a race that has been fed by Professor Riley for eighteen years upon the Osage orange (*Maclura aurantiaca*). The silk from this maclura-fed race proves to be as good as that produced from the mulberry. There is also a series of objects employed by the Department in the distribution of silkworm eggs. It is, however, in that part of the display illustrating injuries by insects, and the methods of counteracting these, that the exhibit is more particularly impressive. Thirty-two large drawers contain preparations of insects in their different stages of development, exemplifying the species injurious to cultivated crops and to forest trees. The specimens are arranged according to crops, and begin in each case at the root and continue through all the other parts of the plant. Brief references to the chief literature, with digests of habits and remedies, are given under each. Specially noteworthy is the method of mounting the alcoholic fluid in cylindrical phials, which are supported by a little spring of wire fastened to a block easily pinned to the floor of the drawers. Associated with this collection is a case of insecticide appliances, showing various forms of force pumps and a very instructive series of spraying nozzles, the most interesting of which is probably the series showing the development of the Riley nozzle, which has proved of so much benefit to agriculture. Another series includes forty different samples of various insecticides employed in the United States, amongst which the most important are the arsenites, the kerosene emulsion, and the pyrethrum. Finally, there is a series of suspended frames, inclosing a very large set of woodcut illustrations, representing the original drawings made by Professor Riley during the last twenty-five years, together with a neatly bound set of his official reports and entomological publications during the same period.

[The Agricultural Exhibit of the United States.]

[From the *London Morning Post*, August 15, 1889.]

Comparative chemical analyses of American and European beef have served to bring out some curious points of difference between the beef of the Old World and that of the New. No matter whether the corresponding specimens be sirloin, or rump steak, or fillet, or from any other part of the carcass, American beef always contains a much larger proportion of fat, rather less albuminoids or flesh-formers, and considerably less water than that which has been grown in Europe. The following figures serve to illustrate the differences in the percentage composition of rump steak:

	Water.	Albuminoids.	Fat.	Ash.
European	74.60	19.0	5.42	0.93
American	48.26	15.36	35.56	0.82

The subjoined figures, again, are those obtained as the mean results of the analyses of 21 samples of beef grown in Europe, while the American figures are those which resulted from the analyses of an entire side, excluding the suet, of an ox:

	Water.	Albuminoids.	Fat.	Ash.
European	72.25	21.39	5.19	1.17
American	54.77	17.20	27.07	0.96

It appears, therefore, that while American beef is richer in those ingredients which, in the human body, develop heat and capacity to perform work, European beef has the advantage in the flesh-forming constituents or those that repair muscular waste.

In the United States section of the Paris Exhibition the display of cereals is characteristic and creditable, though smaller than it should be, owing to the limited space allotted to it. It has been prepared with the assistance of Mr. George W. Hill, of Minnesota, and embraces all the leading varieties of grain, many of which are contributed by prominent Western agricultural colleges and experiment stations. The collection of grain in the ear includes 130 varieties of wheat, barley, oats, and rye, showing full length of stalk and arranged in one handsome case, the floor space of which is covered with samples of maize in the ear placed upon black tablets. Two large frames of labeled maize samples supplement this collection. The shelled grain samples are shown upon three double easel stands of six frames, there being 352 samples in all. Another fine collection, principally of wheat and barley, is sent by the Northern Pacific Railway Company, illustrating produce grown along their line. On a stand near this exhibit is a superb collection of cereals in the ear, showing full length of stalk, contributed by the same company.

In the third section of the cereal exhibit are several important contributions, the most striking being the series of 40 milling samples sent by the C. A. Pillsbury Company of Minneapolis. Another series is that of the "breakfast cereals" sent by Messrs. Schumacher & Co., of Akron, Ohio. The Glen Cove Manufacturing Company, of Long Island, N. Y., shows maizena, and cereal products are also sent from New Haven, Connecticut, and other districts, and include Indian meal, crushed wheat, hominy, etc. The commissioner of agriculture of South Carolina sends a very complete exhibit of rice, comprising 16 varieties. A new article is exhibited in this section, namely, oil made from the germ of the maize grain. It comes from Philadelphia; it is rank in flavor, and it is doubtful whether it will ever acquire any important commercial value. The photographs illustrating methods of cribbing corn and of storing and milling various grains are interesting, but some regret must be expressed that space could not be obtained for a grander show of maize. The cereal output of the United States in 1887 was, of maize, 1,665,441,000 bushels, the produce of 75,694,208 acres, the value being $610,311,000, of which $11,790,046 worth was exported. Of wheat, the yield was 457,218,000 bushels, the produce of 36,806,184 acres, the value being $314,226,020, of which $87,668,833 worth was exported. Of rye there was raised 24,489,000 bushels upon 2,129,918 acres, valued at $13,181,330; and of oats the yield was 624,134,000 bushels from 23,658,474 acres, the value being $186,137,930, of which $343,659 worth was exported.

A large exhibit of preserved and canned vegetable products includes sweet corn, pease, beans, tomatoes, asparagus, okra, gumbo, and "succotash," the canning industry of some of the larger Eastern firms, as of Baltimore and Rochester, being well represented. The tenderness and succulence, the fine flavor and rich color—not due to any artificial means—of these products have excited much admiration among those who have carefully examined them. There is also a series of bottled pickles and preserves, besides a case containing seeds of the principal vegetables. Hops of excellent quality are shown, and even samples of castor oil from Packer County, Texas. The money value of the vegetable products of the United States is estimated on the statistical charts at $78,000,000 for potatoes, $20,000,000 for sweet potatoes, $13,800,000 for pease and beans, and $68,000,000 for other truck products. A report on vegetables, by Mr. M. G. Kern, accompanies the exhibit, while photographs, illustrating hop-picking, cranberry-sorting, celery fields, etc., add to the general interest.

American fruits are illustrated by a well-executed series of wax models, by colored plates of fruits, and by photographs of orchard and fruit-farm scenes. In preparing this exhibit, Professor Riley has had the assistance of Mr. H. E. Van Deman, pomologist to the Department of Agriculture at Washington. There is a fine

collection of canned and dried fruits from the Eastern States and from California, including green and preserved oranges, dried apples, peaches, prunes, plums, pears, cranberries, whortleberries, blackberries, pineapples, together with raisins and English walnuts from California, pistachio and pecan nuts raised in the same State; also pickled olives and olive oil. Ripe oranges from Florida and California are also on view, though, on account of the distance and of the difficulty of getting fresh fruit over the ocean at the proper time and in good condition, little attempt has been made in this direction. Consequently this section of the exhibit affords but a poor idea of the fruit industry of the States. The fruit product is valued at $175,000,000, of which $1,500,000 worth is exported annually.

The wine industry is naturally associated with fruit production, and the wines of the United States are represented by 42 different exhibitors, chiefly from California, the leading wine-growing section of the country, though the principal Eastern wine-growers are also in evidence. There are all sorts of wine—white wines, red wines, sparkling, and sweet wines, also brandies and alcohols, russet and champagne ciders. In the State Exhibition of Florida is to be seen a strong alcoholic cordial made from oranges. Among the wines tasted there were some that were certainly excellent in their way, such as Medoc Souvenir and Sauterne Souvenir, from Mr. Westmore's vineyards at Cresta Blanca, California; Sauterne from Chauché, Mont Rouge vineyards; Cabernet from the Napa Valley Wine Company; Eclipse Champagne from Arpad Haraszthy & Co., and others from the Pleasant Valley Wine Company, etc. These American wines have their special characteristics, just as have our Australian wines, and, like these, they are stronger—more alcoholic—than the corresponding French wines. But the exhibit, considering the traveling it has undergone, shows very clearly that America, in the near future, is destined to be no mean competitor of France in the wine trade of the world. The viticultural exhibit has been got together by Mr. B. F. Clayton for the Eastern States and by Mr. George Husman for the Pacific regions. A number of illustrations portray some of the larger vineyards, wine vaults, and grapes in bunch. A collection of 26 native species of grapevine and a series of native rooted plants are shown by Mr. T. V. Munson, in view of the interest manifested in them by French cultivators. The annual wine product of the United States is valued at $70,000,000, of which $129,103 worth was exported in 1888.

The development of the sugar industry in the United States will be watched with special interest by English manufacturers. The American Government has for many years been solicitous of encouraging the cultivation of sugar-bearing plants, and the sorghum plant in particular has received much attention from the Department of Agriculture. The result of considerable labour is embodied in the instructive collection prepared by Dr. H. W. Wiley, the chemist of the Department. It includes not only specimens of the sorghum plant and its seeds in full variety, but also samples of sorghum sirup and refined sugars in all stages of manufacture. These samples are from the Douglas and Conway Springs sugar refineries, and are made from sorghum grown upon the experimental farm of the Department at Sterling, Kansas. This collection has attracted much attention from the French, and especially from the Algerians, who are greatly interested in the plant. Of late years the sugar-yielding capacity of the sorghum plant has been considerably increased by careful cultivation and a rigid selection of seed. The manufacturing process has also been much improved by the adoption of the diffusion method. The great economies in the methods of cultivation and the processes of extraction and refining indicate for this comparatively new product an important position, at no distant day, in the American market. Some fine maple sugar is shown, together with photographs illustrating the gathering of maple sap and the manufacture of the sugar. Where all that is to be seen is so praiseworthy it seems churlish to notice a defect, but it certainly is surprising that the cane and beet sugar industries are not illustrated at all. The annual value of the sugar and sirup product of the United States is estimated at $33,500,000.

[The Agricultural Exhibit of the United States.]

[From the *London Morning Post*, August 21, 1889.]

The industries devoted to the production of textile fabrics are so extensive and so important that it is no matter for surprise that the agricultural section of the United States exhibit at the Paris Exhibition should contain a representative display of textile fibers. In forming this instructive collection Professor Riley has had the assistance of Mr. Charles Richards Dodge, son of the accomplished statistician of the Department of Agriculture at Washington. The object kept in view has been not only to exhibit the various commercial fibers of the country, but also to illustrate

the resources of the United States in the direction of fiber production by means of complete series of all the varieties, whether indigenous or introduced, which will grow upon its soil. The wool collection is a most valuable one, a series of 100 specimens of clips from prominent growers, illustrating the principal breeds of sheep, having been contributed by the Department of Agriculture. Another series, in four sections, contributed by the leading wool brokers of New York, Philadelphia, and Boston, illustrates the various grades of native wools recognized by the trade, and includes some very fine samples. The manufacture of woolen goods is exemplified by exhibits of processes, from the raw material to the finished article, in several lines of fabrics. Of cotton two fine collections are shown—the first made by the corps of statistical correspondents of the Department of Agriculture at Washington, and comprising 50 samples, and the second being a collection of 40 hand specimens from Professor Stubbs, of the Louisiana State Experiment Station. A third collection of lint cotton embraces some 25 leading varieties of the ginned staple, and includes some magnificent specimens of Sea Island cotton from South Carolina. A handsome series of official grades of American cotton prepared by the New Orleans Cotton Exchange, and sent under seal, illustrates the commercial phase of the cotton interest. Leading varieties of cotton seed are shown, and with them samples of cotton-seed oil and its products, as oilcake and soap. Cotton manufacture is illustrated by several cases of samples showing all processes in the manufacture of a spool of cotton thread, cotton sheeting, white goods, etc.

While hemp and flax production are of secondary importance in the United States, a complete series of these fibers in all stages from the raw to the manufactured article is shown, including the results of recent experiments in the way of cheapening the production by improving the methods of preparation. In this connection the processes of Mr. Boyce, of New York, and of Dr. Roberts, of Washington, are especially interesting. The cultivation of jute and ramie fiber in the United States is fully illustrated, although the fiber has as yet only passed through the stage of successful experiment. The samples demonstrate that with suitable machinery both these fibers may be profitably grown in the States. A series of specimens illustrating the manufacture of burlaps, bagging for cotton baling, carpeting, etc., from the leaves or needles of the Southern pine deserves to be noticed. Other Southern fibers, such as the agaves, yuccas, etc., and the various species of mallows, asclepias, etc., which are capable of cultivation, complete the series. The wool product of the United States in 1887 was worth $77,000,000, of which only $70,202 worth was exported, while the hemp and flax product, of which none is exported, was valued at $9,000,000. The value of the cotton product was $257,295,327, of which nearly $178,000,000 worth was exported. Tobacco is exhibited in every stage, from the crude leaf to the manufactured products, and is presented in every variety from many different States. There are fine specimens of leaf tobacco from Maryland, Virginia, North Carolina, Kentucky, and Tennessee, the tobacco from these States being generally destined for use as pipe and cigarette tobacco, and also for various kinds of chewing tobacco. Leaf tobacco to be made into cigars is shown in great variety from Connecticut, New York, Pennsylvania, Wisconsin, and Florida, this last-named State having produced a little within the last few years. Manufactured tobacco is not shown in the agricultural section, but the agricultural show is suitably supplemented by fine displays of cigars and cigarettes in the industrial section. Professor Riley had the assistance of Mr. Alexander Macdonald in the preparation of this exhibit. The production of tobacco in the United States in 1887 was 532,537,000 pounds from 750,210 acres of land. The value was $39,468,218, of which $20,510,386 worth was exported.

As illustrative of economic botany may be noticed a comprehensive exhibit of American grasses and fodder plants, prepared by Dr. George Vasey, botanist to the Washington Department. The grasses of the great Western plains are arranged under their botanical names, side by side with the cultivated pasture grasses of the Eastern States. Here may be seen Kentucky blue grass, Texas grass, timothy grass, and several leguminous plants, including lucerne or alfalfa, and Japanese clover, which are freely grown in the West, Southwest, and South. In all there are 400 specimens of grasses and other forage plants in glazed frames, and samples of 32 different kinds of hay principally from the West and from Georgia. Grass is still one of the primary crops of the United States, and one of great value. Some idea of this value may be formed by calling to mind the proposition of the ranchmen that Congress should provide a trail 10 miles wide from Texas to the northern frontier of Dakota, a distance of over 1,300 miles, for the use of the drovers. Besides the samples of grasses and hay, there is a series of enlarged photographs of scenes illustrative of haymaking processes and hay implements, and also a series of samples of silage from experiment stations. The forestry section comprises 24 exhibitors, who show forest products in a variety of ways, but who have united their contributions in a collective exhibit, prepared with the assistance of Professor B. E. Fernow,

chief of the Forestry Division at Washington. It comprises samples of American woods from various sections of the Eastern States and from California, notable among them being the redwood of the Mariposa groves, several very large planks of which are shown, one of them in the form of an immense table. This wood is extensively used for building, and particularly for interior decoration and for furniture. A very prominent exhibit, made by Professor Fernow, is a collection of wood sections and herbarium specimens, representing 125 species of timber trees most important from the economic standpoint. The specimens are accompanied by explanatory lables, showing botanical position, with descriptive notes for each species. The Massachusetts Society for the Promotion of Agriculture has sent a handsome set of the "Michaux Sylva," comprising 240 colored plates representing the forest flora of the United States. In the series showing the anatomy and structure of woods there is a handsome collection of veneer sections of 16 species of wood, radial, tangential, and transverse, furnished by Messrs. Charles W. Spurr & Co., of Boston. Another beautiful series, showing 25 species in 27 sheets, with text in book form, was sent by Romeyn B. Hough, Lowville, New York. There is also a series of photomicrographs of 21 woods. The forest industries are well represented by maps and charts, prepared by Professor Fernow, also by photographs of forest trees and of lumbering scenes, and likewise by collections of seeds and fruits in bottles, and by models and tools, utensils, and machinery used in logging. Samples of tan bark and tanning extracts, turpentine products, etc., are also to be seen. An interesting object is the model of a tree-planting machine of exceptional merit, designed by Professor Fernow. It is operated by five men, and is reported to have planted as many as 10,000 trees in a single day. The forest industries are further illustrated by a large series of photographs and drawings, which, however, from want of space, are unfortunately not exposed to view.

[The Agricultural Exhibit of the United States.]

[From the *London Morning Post*, Sept. 3, 1889.]

In the American agricultural section of the Paris Exhibition Professor Riley has contrived to find room for a few educational exhibits. In the direction of economic ornithology and mammalogy four small maps, showing the geographical distribution of mammals and birds of economic importance, represent this branch of the departmental work at Washington. As to food adulteration, Professor Thomas Taylor, microscopist of the Department, sends a series of some 60 micrographs, illustrating the various crystalline formations of butter and other fats, and the structural characteristics of certain condiments. In the series of butter and other fats there are 167 photographs of crystals of butter, and over 100 photographs of crystals of other fats, including beeswax and cotton-seed oil stearine. The primary object of the investigation from which these exhibits were derived was the discovery of a means of discriminating between pure butter fat and its imitations. There are also three plates illustrating Dr. Taylor's freezing microtome (the instrument itself being exhibited in the Industrial Hall), and two other instruments of precision invented by him. As to fungoid diseases of plants, the collection of Professor B. T. Galloway, vegetable pathologist to the Washington Department, is embraced in 25 framed colored drawings of fungal diseases, seven maps showing the distribution of such diseases in the United States, and 15 large photographs relative to their treatment. The exhibit of agricultural statistics, prepared under the direction of Mr. J. R. Dodge, the statistician of the Department, includes 20 diagram maps and charts relating to the production of the staples of American agriculture. Four large maps illustrate the areas of cultivation of wheat, maize, oats, cotton, and tobacco, the volumes of the crops of 1859, 1879, and 1887, for each product, being shown comparatively. Two charts are devoted to the product and export of maize, and the effect of varying product upon price. Another chart exhibits graphically the progress of cereal production for five periods by decades, beginning with 1849. An interesting comparison is made of the product per capita of cereals in Europe and the United States, and on another large chart a comparative illustration is made of the dietaries of the people of different countries in varied professions. One of the most comprehensive charts shows the products of American agriculture and their value, with the proportions of home consumption to export shown in squares, each representing $500,000. Each product named is accompanied by figures setting forth the total production and the volume of export with the exact percentages indicated.

Other charts refer to wages of farm laborers, production of farm animals, meat exports, foreign trade, increase of railroad mileage in the United States, etc. The exhibit of agricultural science and education consists of some 200 photographs illustrative of agricultural colleges and experiment stations throughout the States, show-

ing their principal buildings, schools, laboratories, museums, greenhouses, and barns, together with some photographs of fine cattle. Within the last two years the State agricultural colleges have received national aid to the extent of $15,000 each for the establishment of agricultural experiment stations and within the last year Professor W. O. Atwater, who sends the above exhibit, has been called to the head of the new Bureau of Experimental Stations, in the Department of Agriculture. American breeders could not risk sending their valuable cattle across the sea, but they have given some idea of their resources in live stock by means of an admirable series of photographs of American-bred dairy cattle, which represent the American Jerseys, Guernseys, Ayrshires, and Holsteins. The American ideal of a good butter cow is an animal of from 800 pounds to 1,000 pounds live weight, producing from 30 to 40 per cent. of her weight in butter, or her entire weight in cheese, in a year. In addition to these photographs of cattle are some very fine pictures of American-bred horses, including Percherons and French coach horses. There are also pictures of various American breeds of beef cattle. Pamphlets, in French, upon the various subjects illustrated by the American exhibits have been prepared by experts under the direction of the Secretary, and may be obtained of members of the Commission, or at the Exhibition.

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Professor C. V. Riley, having completed his duties as United States Agricultural Commissioner in Paris, was last week entertained at a complimentary banquet on the eve of his departure. Mr. Norman J. Coleman, the first Secretary of Agriculture who ever sat in the Washington Cabinet, and M. Leon Grandeau testified to the marked success of Professor Riley's efforts, and the guest of the evening made a happy response, first in English and afterwards in French. Professor Riley is now in England, and sails from Liverpool in the *City of Berlin* on the 11th inst.

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